JPRS Report

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Dual Source Lighting By Sodium Vapor and Metal Halide Lamps

[Article by S. V. Volkova, V. S. Litvinov, N. P. Petrenko]

[Abstract] Changes in the color and light parameters of radiation produced from dual source lighting by high-pressure sodium vapor lamps and metal halide lamps of various spectral composition are calculated. The ratio of luminous fluxes from the high-pressure sodium vapor lamps and the metal halide lamps is used as the variable parameter in the calculations since this makes it possible to simulate actual illumination conditions (different quantities of lamps of various types; different lamp configurations, types of bulbs, etc.). The tested lamps include high-pressure sodium vapor lamps, In-Na-Tl, Na-Sc, Tl and Dy-Ho-Tm metal halide lamps. Plots of the color and light parameters of the lighting fixtures as a function of the luminous flux ratio of the two types of lamps are provided. The data reveal that light output of the dual source lighting fixtures grows for all designs with an increasing luminous flux ratio, and this light output approaches that of a sole high-pressure sodium vapor lamp. When high-pressure sodium vapor lamps are used in conjunction with other lighting sources, the effect of the illumination conditions of the lighting fixtures must be taken into account in the design stage (such factors as the lighting configuration, supply voltage stability, presence of vibrations, etc). The analysis reveals that by using this approach to improving the light transmission quality of high-pressure sodium vapor lamps, it is possible to significantly simplify control over the light parameters of the lighting fixture.

Emergency Lighting Fixtures With a Self-Contained Power Source

[Article by V. A. Volchenko, M. G. Lyakhov, V. B. Tokarev]

[Abstract] The development of the LBP02-8 model lighting fixture, the first Soviet domestic series of emergency lighting fixtures with a self-contained power source, is reported. This model was developed and produced by the All-Union Scientific Research and Design Institute of Light Engineering in 1989 and employs fluorescent lamps as the light source. The unit also includes a charger and a remote control unit. A schematic of the electronic control system is provided together with performance specifications, including continuous operating time (better than one hour); luminous flux output (150 lumens); charge time (sixteen plus or minus one-half hour); supply voltage (220 volts); weight (2.5 kilograms) and approximate cost (220 rubles). The unit is scheduled for commercial manufacture in 1991.

Operational Strategy in the Field of High-Pressure Discharge Lamps and Wiring Configurations

[Article by T. A. Agafonova]

[Abstract] The proceedings of a round-table discussion held at the editorial offices of the journal Svetotekhnika on July 3, 1990 are reported. Representatives from the All-Union Scientific Research and Design Institute of Light Engineering, the Poltava Special Technical Design Bureau for Light Sources, the Department of Light Engineering of the Moscow Electrical Engineering Institute and the All-Union Scientific Research Institute of Light Sources were in attendance. The central discussion concerned the DRL, DNaT and DRI model high-pressure discharge lamps of domestic Soviet manufacture, as well as their wiring configurations, and their prospects for the next five to ten years. Several problems in manufacturing and supply strategies are cited, including the efforts of Soviet designers to manufacture the simplest possible lighting fixture while leaving issues of reliability and maintenance to the repair enterprises. Operational problems with the lighting fixtures are commonly simple failures, and the overall units therefore have very poor reliability. Other problems include the increasingly complex relationship between the manufacturer and customer in current Soviet market conditions, and current supply and demand problems. Those in attendance also questioned quality control practices in the field of light engineering, claims that foreign lamps are superior and that Soviet lamps work better in foreign fixtures. A survey of lamps manufactured abroad and other foreign practices is also provided.

Effect of the Coefficient of Thermal Expansion of Glass on Incandescent Lamp Sealing Rejects

[Article by V. V. Volgin, V. I. Kartashova, A. F. Ratseev, V. F. Fedorov]

[Abstract] The effect of the thermal expansion of glass, which produces internal thermal stresses that may result in failures, on the reject rate in incandescent lamp manufacturing is analyzed. The analysis focuses on the four different causes of thermal stresses in lamp bulbs which include nonuniform surface heating; nonuniform bulk heating; local, severe changes in temperature due to contact with other objects and the differential in the coefficients of linear thermal expansion of the solder materials. The bulb sealing operation is used as the basis for the analysis. Specific modifications in manufacturing operations are recommended as a result of the analysis for moderating high bulb reject rates. These include maintaining specific bulb heating and cooling conditions that account for the difference in the coefficients of linear thermal expansion of the bulb, the socket material,

Computer Viruses

[Article by A. Gutnikov]

[Abstract] This article is intended to familiarize Soviet personal computer users with the threat of computer viruses. First appearing in the Soviet Union in 1988, viruses spread rapidly until at least 11 types were known in Moscow as of January, 1990. A table lists some of the most common file viruses, indicating the amount by which they enlarge the COM and EXE files which they infect. The author has written an antivirus program called STRAZh capable of detecting attempts by any virus program to seize control of the computer by any of the eight possible ways which viruses can use. This new virus program does not depend on any list of known viruses, and is capable of detecting any virus infecting the computer. No information is given on what the eight methods are, how the program detects them or where to obtain a copy of the program.

4USTsT Television Sets

[Article by B. Braynin, V. Serikhin and T. Brod]

[Abstract] This article presents a technical description of the MR-401 scan module of the 4USTsT television set. Schematic diagram are included, but the circuit board layout is not illustrated.

Interface Converter

[Article by A. Dolgiy, Moscow]

[Abstract] A converter attachment to the interface of a Radio-86RK computer is described which decodes signals recorded and stored on magnetic tape rather than diskettes and then converts them into signals compatible with a standard RS-232C sequential interface for transfer to a more sophisticated computer for proper processing. Decoding is done by reading on one of the signal fronts a time interval 25% shorter than the time taken for transfer of one bit and then assigning a logic "1" or a logic "0" to that bit depending on whether the signal is at a level above (positive) or below (negative) a certain threshold level. This procedure is repeated by similar treatment of the next signal front. Correct decoding and splitting of the bit flux into bytes requires initial synchronization of the process, for the purpose of which first a series of "0" bits and then a beforehand chosen sync byte are transferred prior to transfer of each data block. After reception of each bit, the following eight bits are then compared with the known value of the sync byte, an equality indicating that synchronization has been achieved. Comparing the received code not only with the sync byte but also with its inversion is necessary, since the signal phase may reverse during the record-reproduce process. The interface converter was tested with "Robotron-1715", Neyron 19.66", Standard System 1840, and other computers. Figures 6.

Reception of Satellite Television Programs: "Moskva" System and "Ekran" System Antennas

[Article by G. Tsurikov, A. Kvitko, and V. Fadeyev, Moscow]

[Abstract] Two paraboloidal antenna with exciters have been designed for individual reception of satellite television programs. The existing "Moskva" system antenna for the 3,675+/-16 MHz frequency band, with a 1.4 voltage standing-wave ratio, a 37.5 dB gain, and first side lobes suppressed to -20 dB level, has a 2.5 m diameter and a 160° aperture angle. An antenna 1.5 m in diameter and with all linear dimensions scaled down accordingly will have the same electrical performance characteristics, except a gain of only 33 dB, quite adequate for individual reception. It also should be mounted on a pedestal so that it can be oriented in a vertical plane and in plane orthogonal to the latter. Its exciter operates with a low-noise amplifier and uses coaxial-waveguide connectors. Its most significant feature is a double-thread conical helix consisting two single-thread ones turned around 180° apart and with the narrow ends soldered to the radome. An antenna of the "Ekran" system for individual and communal reception of satellite television programs transmitted over the two 714+/-12 MHz and 754+/-12 MHz channels must have a gain of 18-21 dB. Such an antenna consisting of two horizontal cophasal "wave channel" arrays in each of two tiers will have a gain of 21 dB, only up to 18 dB when having only one such tier. Each array includes a helix, a reflector, and a set of directors, made of strips of AMGN aluminum alloy and all mounted on a boom made of a 2 mm thick duralumin tube 28 mm in diameter. The antenna is mounted on a 2.5-3 m high pedestal so that it can be rotated for orientation at different azimuth and elevation angles within a +/-15° clear solid sectors. A prototype of this "Ekran" antenna was tested and found to have a 20.8-21.5 dB gain and a 0.7-0.9 traveling-wave ratio at the download feeder input over the 702-764 MHz frequency range, an ellipticity factor of 0.77-0.88 in the horizontal plane, and a radiation pattern with a 9° wide (half-power level) major lobe between two side lobes not exceeding the 35% level. Figures 13; references 4.

Television Sets 2USTsT and 3USTsT Operating in "Monitor" Mode

907K0321C Moscow RADIO in Russian No 6, Jun 90 pp 44-46

[Article by K. Filatov and B. Vanda, Taganrog]

[Abstract] Considering that video cassette recorders as well as personal computers can be hooked to a television set when the latter is switched to operation in the "monitor" mode, hooking an Elektronika VM-12 cassette to a 2USTsT color television set which has a USU-1-15 sensory control device and to a 3USTsT color television set which has a KVP2-1 push-button program selector is described in detail. Hooking to such a 3USTsT set is more difficult, because of the total color signal and the synchronization signals are fed to it separately. The connector module has two transistors and four resistors. It is important to note that the video signal must go to the base circuit and not to the emitter circuit of the transistor in the emitter-follower stage, the latter having for this reason been modified into one with load division. Figures 3.

Sensory Device For Control of Electrical Record Players

907K0321D Moscow RADIO in Russian No 6, Jun 90 pp 50-52

[Article by I. Kloss, Moscow]

[Abstract] Several sound reproducing systems are now produced in the USSR which include Polish-made "Unitra" model G-602 high-fidelity electrical record players. These record players were designed a long time ago and do not meet present performance requirements, but they were designed so as to facilitate future modifications. A device is proposed which will make the performance of these record players substantially more reliable. It is a set of electronic switches with sensory control, to replace existing push-button mode selectors. The device consists of three independent modules and contains altogether five identical sensor cells. The disk speed selector module contains two sensor cells and a trigger. The automatic-stop activator contains one sensor cell, a pulse front shaper, and a counting trigger. The control module contains two sensor cells and two transistor switches. The state of each module is indicated by five corresponding light-emitting diodes. Pulses from either of the two sensor cells in the disk speed selector appear at the S input or the R input of the trigger in the same module and switch it into the state corresponding to either 33 rpm or 45 rpm. This trigger sends control signals through the indicator panel to the control module. All components, except the sensor pads and the light-emitting diodes, are mounted on a 35 mm wide and 108 mm long printed-circuit board. Three of the light-emitting diodes should be green, the other two indicating START and STOP respectively being preferably red. The transistor in the automatic-stop activator module can be any of series KT815 or KT815, all six others can be any of series

KT312 or KT315. All four diodes can be KD509A diodes or of any equivalent and not necessarily silicon series. The printed-circuit board is laid out for mounting MLT, OMLT, S2-33 resistors and KM-5, KM-6, K50-6, KM50-16 capacitors. Figures 3; references 1.

Computer Checks Transistors

907K0221A Moscow RADIO in Russian No 3, Mar 90 p 42

[Article by A. Sergeyev, Moscow]

[Abstract] A simple program is proposed for checking transistors and semiconductor diodes by a Radio-86K computer. A given device is connected to the KR580VV55 microcircuit of the D14 computer module through a special attachment and to A, B, C terminals of the monitor, which activates the program with a GO command. On the monitor screen under the three symbols A B C will appear the type of conductivity which corresponds to the connection scheme, say N N P in the case of a transistor or say P X N in the case of a diode connected across terminals A and C. When any junction in the device is shorted, then a 0 will appear under the corresponding symbol. The program does make a distinction between emitter and collector leads so that collector lead must, if necessary, be identified by some other means. The collector lead, however, is usually not connected to the metal case and is usually located between emitter and base leads in a plastic case. After the program has been started, it continues without interruption revealing all changes at the device terminals until it is terminated by pressing any key. In power transistors and in old germanium devices the uncontrollable initial currents can of the same order of magnitude as the test current, about 1 mA, and therefore checking them may not always be error-free.

Model 4USTsT Television Sets: Radio Channel and Sound Track

907K0221B Moscow RADIO in Russian No 3, Mar 90 pp 43-49

[Article by O. Gaznyuk, Moscow]

[Abstract] The radio channel of 4USTsT fourth-generation color television sets features several improvements over that of the preceding 3USTsT model, namely an SK-V-40 all-wave channel selector and a new i-f image amplifier. The sound track of the 4USTsT television sets, a quasi-parallel one, is more reliable and interference-immune than the sound track in the previous model. The channel selector has two channels, for reception of metric waves and decimetric waves respectively, with a common output through a frequency divider. The decimetric-wave amplifier is built on a KP327A double-gate field-effect transistor (VT1) and is followed by a self-generating mixer built on a KT3165A bipolar transistor (VT3) and the latter by a TDA5030A preamplifier microcircuit (D1) with one output to the

common KS193PTs1 frequency divider (D2) and one output to the mixer in the metric-wave channel. In this channel the metric-wave amplifier is built on a KP327B double-gate field-effect transistor (VT2) and followed by a TDA5030A microcircuit consisting of a heterodyne oscillator, a ring mixer, and a preamplifier which feeds the frequency divider and also puts out separately an i-f signal. The main feature of this channel selector is the symmetric output of i-f signals. The i-f signals pass to a surface-acoustic-wave filter serving as sound track selector. This filter not only extracts the appropriate frequency band from each channel, forming the necessary amplitude-frequency and phase-frequency characteristics, but also suppresses interference signals. The television set can be easily repaired and can operate with a hooked-on video tape recorder. Figures 7.

Optimum Setting of Bias Current in Magnetic Tape Recorders

[Article by I. Mikhaylin and A. Popozov (deceased), Tula]

[Abstract] A method of optimally setting the bias current in magnetic tape recorders built with an all-purpose amplifier is proposed involving creation of an artificial through-feed recording-playback channel, with the erasing head used as recording head while the bias current is being set to its optimum level while the recorder operates first in the "playback" mode and then in the "record" mode. The apparatus for optimizing the bias current includes a d.c. regulator (one transistor) with resistor control, a 75-85 kHz erase-and-magnetize oscillator (two transistors), and a 1 kHz reference oscillator (two transistors). The proposed method avoids the difficulty in setting the bias current to its optimum level according to the "maximum carrier output" criterion, inasmuch as the carrier output does not peak sharply enough, other methods such as discrete regulation of the bias current being too laborious and microprocessor-aided signal analysis after trial recordings being too imprecise. Figures 3; references 5.

Model "Ural-RP340A" Car Radio

[Article by S. Demin, Sarapul, Udmurt ASSR]

[Abstract] The latest car radio model Ural-RP340A to be produced at the Sarapul Radio Manufacturing Plant is designed for the Oka economy car and priced at 120 rubles maximum. It features automatic frequency control (AFC) and noiseless tuning (NLT) during automatic station selection within either of two long-wave (148.5-283.5 kHz) and ultrashort-wave (65.8-74.0 MHz) broadcast bands, both AFC and NLT being turned off for manual station selection, also an electronic indicator

with brightness control and smooth regulation of sound timbre. The receiver is energized from the nominally 14.4 V car battery and operates under voltages from 10.8 V to 15.6 V. Its real sensitivity is 200 µV in the long-wave band and 4 µV in the ultrashort-wave band. Its nominal maximum output power across an 8 ohm load is 3 W and 8 W respectively. The ultrashort-wave channel has a 0.08- 12.5 kHz audio range. The receiver operates with "fixed logic", which eliminates the problem of electromagnetic compatibility of digital and analog receiver components. The receiver consists of three functional modules: transistor AM and FM channels mounted on a common board and CMOS control logic mounted on a separate board. In addition there are a luminous indicator acting as electronic dial and a filter which suppresses interference from the ignition system on separate boards each. The receiver weighs not more than 0.8 kg. Figures 2.

Outlook for Development of Home Radio Equipment

[I. G. Glebov, member of RADIO editorial staff, first deputy chief, Main Administration of Scientific and Technical Development at USSR Ministry of Communication, Moscow]

[Abstract] Production of home radio-electronic equipment in the USSR is projected for the 1995-2000 period on the basis of 1987-1990 data which cover black-and-white as well as color television sets, radio receivers, magnetic tape recorders, video tape recorders, and record players including those for compact disks, also urban and rural telephone sets. Most significant latest developments include digital techniques and equipment for all modes of communication, portable radio stations, laser techniques of sound recording and playback, high-definition television, flat-screen and wide-screen (120 cm) television sets, and paraboloidal antennas for reception of programs transmitted via satellite. Figures 11; tables 4.

Electronic Aide for Deputies to Supreme Council of USSR

[Article by A. Smirnov]

[Abstract] The second session held by the Supreme Council of the USSR was the first one aided by an electronic system of coverage for vote tally. The design of this system is based on a 15x80 diode-resistor array covering the 15 rows of seats in the chamber of deputies with the largest number of 80 seats in the top row. Each deputy has an assigned place and is provided with a small table for writing and an attached push-button activating his diode. The system is controlled by commands issued

from a single panel by the presiding officer, who can make the system indicate "for", "against", and "abstain" votes. The principal components of the system, besides the aforementioned diode-resistor array, are a control panel, a microprocessor control module, two display boards on the left wall and on the right wall respectively, and a personal computer connected to the control module. This module contains a microprocessor, a clock pulse generator, a system monitor, an address register buffer, a random-access memory, a reprogrammable read-only memory with electrical data recording and ultraviolet-optical data erasure, four address signal decoders, a programmable timer with a timer reference oscillator, two parallel input-output interfaces IPVV and one series input-output interface PIVV, the IPVV-1 parallel input-output interface being connected to a microprocessor status indication amplifier, a manual/automatic mode selector buffer, a column (seat in a row) decoder, a set of control panel status indication amplifiers, and two sets of display board amplifiers, the IPVV-2 parallel input-output interface being connected to an optronic row signal amplifier and an amplifier of command signals from control panel, and the PIVV series input-output interface being connected to a connection adapter. Signals between functional microprocessor components are transmitted through three trunk busbars, a control busbar, and an address busbar. The personal computer is an IBM PC/AT compatible one with a "Winchester"-type 40 Mbyte hard disk as external storage. The system is far from perfect, several flaws and deficiencies need to be eliminated. It will be necessary, for instance, to add push-buttons for activating an "I wish to speak" and "the chair recognizes" exchange between deputy and presiding officer. It is also desirable to supplement the display boards with an alphanumeric follow-up. Figures 1.

Satellite-1990

*907K0167C Moscow RADIO in Russian No 1,
Jan 90 p 9*

[Article by editorial staff, RADIO]

[Abstract] In early 1991 will be launched the Doppler navigational satellite of the "Tsikada" (Cicada) series which had been completed, including RS-12 and RS-13 radio amateur radio relays aboard. These relays are near duplicates of the RS-10 and RS-11 models, with only slight modifications made under the supervision by A.P. Popkov at the design office associated with the Historical Museum of Astronautics. The satellite will be pulled into orbit at about 1000 km altitude above Earth, at a 83° inclination angle, and will circle Earth in 105 min. The radio relays have been designed for a maximum output power of 8 W and for simultaneous communication in mode A (from Earth over 144 MHz channel and to Earth over 28 MHz channel), in mode K (over 21 MHz and 28 MHz channels), mode T (over 21 MHz and 144 MHz channels), in mode

KA (from Earth over 21 MHz channel and to Earth over both 21 MHz, 144 MHz channels and to Earth over 28 MHz channel), or mode KT (from Earth over 21 MHz channel and to Earth over both 28 MHz, 144 MHz channels). Operation in the same all modes will be available for reception of beacon and quasar signals. Figures 1.

UDC 778.53:620.178.53

Using Correlation Method of Vibroacoustic Diagnostic Testing on Motion Picture Equipment

*907K0157A Moscow TEKHNIKA KINO I
TELEVIDENIYA in Russian No 1, Jan 90 pp 21-24*

[Article by Yu. P. Shchevyev, N. A. Smirnova, and A. B. Lebedev, Leningrad Institute of Motion Picture Engineers]

[Abstract] Vibroacoustic diagnostic testing of motion picture equipment by the correlation method is considered, inasmuch as the spectral method becomes unreliable when the overall level of the vibroacoustic noise signal is comparable with or exceeds the level of the parasitic discrete spectral component which indicates a defect. The correlation characteristics of signals serving as indicators and estimators of the state of an object are calculated in a conventional manner, assuming that both the first acoustic signal and the delayed second one are stationary ergodic processes. Analytical expressions for their cross-correlation and autocorrelation functions are derived on this premise. Since the autocorrelation function of a stationary random process is an even function of the time delay and its maximum value corresponds to a zero time delay, and the cross-correlation function does not depend on the sequence of the two ergodic processes, hence both cross-correlation and autocorrelation coefficients are never larger than unity and moreover decrease with increasing time delay so that the signals eventually become noncorrelated when the time delay is sufficiently long. This is illustrated first on two cosinusoidal harmonic signals out of phase with generally different amplitudes, their cross-correlation coefficient being equal to the cosine of their phase difference, and then on any two periodic signals expandable into Fourier series. For vibroacoustic diagnostic testing it is essential that the autocorrelation of function of a periodic signal be a periodic and nondecreasing function of the time delay. Application of the correlation method to motion picture equipment is demonstrated on a periodic sounding signal and an echo signal consisting of two additive components: a periodic signal produced by collisions between members of a kinematic pair and a noise signal produced by all kinds of other interactions in the mechanisms of a "Ksenon-3A" model 35K1AU4 No 501 motion picture projector or a "Rodina" No 354 motion picture camera. Figures 2; References 4.

UDC 621.397.44:629.78

Future "STV 12" 12 GHz Satellite Television Broadcasting System and Selection of Its Parameters

907K0157B Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 1, Jan 90 pp 24-30

[Article by D. L. Zaytsev and L. Ya. Kantor, Scientific Research Institute of Radio]

[Abstract] Considering that further development of the "Orbita" satellite TV broadcasting system is not economical and that both "Moskva" and "Ekran" systems cannot accommodate more programs owing to IEC assignment limitations, development of a new satellite TV broadcasting system has been proposed so that not only two programs in color can be broadcast over the USSR territory and one program over the territory of each SSR but also regional programs. The logical choice of frequency band was 11.7-12.5 GHz, accommodating 70 channels, and for five positions on the geostationary orbit had been selected 23°, 44°, 74°, 110°, 140° longitude east. The basic design parameters are: size of territory covered, image and sound reception quality indicators, and number of transmitted programs dependent on the program production capability and available broadcasting technology. The basic performance parameters are maximum attainable power flux density and cost. The cost of a ground receiver network decreases and the cost of a satellite increases as the maximum power flux density is raised so that the two cost components must be weighed against each other and the economically optimum design will be at or near the break-even point of both cost components. The satellite broadcasting system consists essentially of ground transmitter stations, airborne relaying complex, and ground receiver stations. For simplification and standardization of the relaying complex in a future multisatellite system, territories "visible" from the geostationary positions have been tentatively classified into small ones (Baltic republics, Moldavia, Transcaucasian republics, Bulgaria, Hungary, East Germany), intermediate ones (Belorussia, Turkmenistan, Uzbekistan, Tajikistan, Kirigizstan, Romania, Poland, Czechoslovakia), and large ones (Russia, Ukraine, Kazakhstan). Figures 2; references 6.

UDC 621.397.43.006(1-87)+621.397.7.037.372

Digital Television Studio: Status and Trends

907K0157C Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 1, Jan 90 pp 30-35

[Article by B. M. Pevzner and T. A. Tarasova, All-Union Scientific Research Institute of Television]

[Abstract] The status of digital television studios in six countries including the USSR is overviewed, with an indication of trends in research and development. All digital TV studios already built convert the three Y, C_R, C_B component video signals received from analog transmitting cameras into linear 8-bit codes, in accordance with CCIR Recommendations 601 and 656, such studios having been developed first in the USSR and in France (CCETT-Thomson) for adoption of the SECAM system and only later also in Great Britain (ITCA, Abekas-Cox, Quantel), in the USA (CBC Engineering, Pinnacle Systems), in Japan (Sony), and in West Germany. The more properly called analog-digital TV studio apparatus developed in the USSR receives signals from three transmitting cameras, two electronic rear projection sets, and a sign generator, each of these signals being converted by an encoder. It also receives signals of three external digital programs and three external SECAM programs as well as signals from a digital color background generator and from an all-purpose electronic test panel. The apparatus includes two SECAM-to-digital converters, two matrix program switchboards, one operating and one standby, a video-effects module, a video-graphics module, a special-effects generator, six shaping circuits, an operating mixer and a standby mixer, and two digital-to-SECAM converters. Four trunk lines transmit digital signals at a rate of 243 MBit/s, two of them being coaxial cables 6.5 mm for transmission over 300 m or longer distances with cable length correction and two of them 1.3 nm wavelength multimode fiber-optic cables for transmission over up to 5 km long distances without repeaters and without cable length correction. The number of operating mixers can be increased to two or three so that more programs can be simultaneously transmitted. Figures 1; references 22.

UDC 621.391

Estimating Space-Time Phase Fluctuations of Radio Waves Caused by Turbulent Propagation Medium

[Article by A. B. Shmelev]

[Abstract] Space-time phase fluctuations of radio waves caused by propagation in the turbulent troposphere or ionosphere hinder coherent reception of signals by large antenna systems. Optimal space-time filtration and interpolation of phase fluctuations requires estimation of the phase of the useful signal at the receiving aperture. The theory of conditional Markov processes in its gaussian approximation is used to derive expressions for the mean square error of estimates and investigate the a posteriori correlation of the estimated fields in the receiving aperture. It is found that considering saturation of the dielectric permeability of the turbulent medium has a significant influence on space-time estimation of phase fluctuations of a radiosignal when noise is present. However, the influence of the wave parameter on the problem is very slight, allowing the use of results obtained by geometric-optic description of the wave field. Figures 7; References: 5 Russian.

UDC 621.396.96

Asymptotic Optimal Signal Detection With Nongaussian Passive Interference

[Article by M. A. Ostrovskiy, Yu. I. Pakhomov, Gorkiy Polytechnical Institute]

[Abstract] An attempt is made to create a model of interference reflected from a group of chaotically distributed irregularities and to use the model obtained to solve the problem of synthesis of asymptotically optimal signal detectors for signals mixed with nongaussian statistically dependent noise. The algorithm synthesized yields a detector in which noise compensation occurs in a linear section, with a nonlinear noninertial converter at the

output of the filter. The algorithm is suitable for deterministic simple signals. Figures 3; References 14; 13 Russian, 1 Western.

UDC 519.9;532.2

Diffraction of High-Frequency Electromagnetic Field on Smooth Convex Surface in Heterogeneous Medium

[Article by M. A. Lyalinov, Leningrad State University]

[Abstract] An asymptotic solution is constructed for the Maxwell equations in a penumbra in a smooth inhomogeneous medium for large but finite distances from a convex scattering surface. The solution is merged with an asymptotic solution in the vicinity of the terminator. The orientation of scattered field vectors is described with displacement along a beam. The asymptotic solution is simplified for a homogeneous medium, and the coefficients of the solution are explicitly calculated from the geometric characteristics of the surface and wave front. The limits of applicability of the equations derived are calculated. Figures 2; References 16: 15 Russian, 1 Western.

UDC 621.396.96

Parametric Control of Antenna Array Radiation Patterns

[Article by Yu. M. Dolganov and P. Ya. Krasinskiy, Institute of Acoustics, USSR Academy of Sciences]

[Abstract] Methods for both programmed and adaptive control of the parameters of receiving antenna arrays are studied, particularly the placement of the deep valley in the reception pattern. The principle of parameterization allows joint solution of problems related to the spatial processing of signals, including adaptive resolution and separation of signals arriving from several directions with control of the level of side lobes in the system. Figures 3; References 10: 7 Russian, 3 Western.

Electrical Capacitance of Metal Shell Covering Part of Dielectric Body Surface

[Article by R. S. Meyerova, P. Sh. Fridberg and I. M. Yakover]

[Abstract] A study is made of the problem of determining the capacitance C of an infinitely thin metal shell covering a portion of the surface of a dielectric body. A strict solution of this problem has not previously been published. A system of integral equations is derived for the change in the normal derivative of potential on the surface and used to construct variational functionals for two different representations of the capacitance. A separate solution is constructed for each functional. The rate of convergence of the solution method suggested is greatest when each weighting function considers the edge singularity of the initial problem. Values of capacitance are presented for a broad range of parameters. Figures 4; References 6: 5 Russian, 1 Western.

Partial Pattern Method in Nonlinear Antenna Array Synthesis Problems

[Article by V. N. Garmash, N. S. Absalyamov]

[Abstract] The partial pattern method is one of the best known and most powerful methods of antenna synthesis. The method is based on superimposition of the amplitude-phase distribution of currents in an array. This article develops a method to apply the ideology of the method on the small scale for nonlinear synthesis of antennas by selecting the system of partial radiation patterns most convenient for local approximation. Examples are presented of the solution of practical problems, including phase synthesis of sector radiation patterns. The approach is distinguished by it clarity, the ability to obtain and analyze solutions in explicit form, and the possibility of constructing procedures convenient for use in dialogue mode on personal computers. Figures 5; References 14: 12 Russian, 2 Western.

Spectral Parameter Evolution Method in Over-Horizon Propagation of Ultrashort Radio Waves

[Article by V. I. Goland, K. V. Koshel]

[Abstract] A simple method is suggested for computing the complex propagation constance to determine the eigenvalues of a one-dimensional edge wave problem. The method is used to compute the complex roots of a dispersion equation in the problem of over-the-horizon propagation of ultrashort radio waves in surface evaporation waveguides, solved by the method of normal waves. Specific computations are presented for characteristic waveguide parameters. The method can be applied to the analysis of statistical problems by numerical modeling. Figures 3; References: 7 Russian.

Radar Determination of Subsurface Structure Characteristics

[Article by V. I. Barantsov and S. P. Panko]

[Abstract] Pulse radar is an effective geophysical method for studying subsurface structures to determine both the geometric and the electrical characteristics of the medium. Very broadband pulses, particularly short radio pulses with a small number of oscillating periods, are effectively used for this purpose. This article studies the possibility of solving the inverse problem of subsurface pulse radar with absorbing subsurface media, suggesting precision measurements of relative phases of the spectral components of the very broadband pulses. Analytic expressions are derived to determine the unknown depths and electrophysical parameters of the subsurface medium. Figure 1; References: 5 Russian.

Resonant Phenomena in Waveguide-Horn Phased Antenna Array Elements

[Article by N. L. Aleksandrov, Yu. P. Vinichenko and A. Ye. Tumanskaya]

[Abstract] A study is made of resonant phenomena in the waveguide-horn elements of a phased antenna array. Two types of resonances are distinguished: those resulting from the geometry of the antenna array aperture and those resulting from the presence of a horn. The qualitative features of appearance of resonances resulting from the latter cause are determined. The possibility is shown of selecting a horn geometry to prevent these resonances. Figures 6; References: 5 Russian.

UDC 550.386.346

Characteristics of Natural VLF Radiation With Earthquakes

917K0021F Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 9, Sep 90 pp 1871-1876

[Article by L. T. Remizov, L. V. Apraksin, S. A. Afanasyev, N. V. Tolstobrova and A. V. Elbakidze]

[Abstract] A description is presented of some of the characteristics of natural radio radiation in the VLF band at 3-30 KHz recorded in a seismically active zone during the period of development of seismic shocks. Recordings were made with an omnidirectional vertical short rod antenna, a broadband VLF receiver and an output device which recorded the intensity of the radiation flux over an assigned threshold level with a resolution of 1 ms, sufficient to record the flux of individual atmospherics or other pulses in the frequency band studied. The averaged daily course of natural radiation is compared on days with and without earthquakes, indicating that the solution of the problem of determining anomalous changes in the field possibly caused by earthquakes requires that the study of natural radio noise be undertaken from a different standpoint than that applied in problems of radiocommunications, navigation, et cetera. Figures 5; References: 4 Russian.

UDC 621.391.01

Characteristics of Modal Signal Detector With Pseudorandom Frequency Tuning

917K0021G Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 9, Sep 90 pp 1923-1927

[Article by A. V. Varlimov, A. V. Prytkov and G. I. Tuzov]

[Abstract] A study is made of the problem of detecting a signal with pseudorandom operating frequency tuning among several frequencies. The noise immunity of detection of such a signal in the presence of additive white gaussian noise, pulse and harmonic noise is analyzed. A modal detector with properly selected parameters is slightly inferior to a selective mean detector in terms of probability of missing a signal with fixed false-alarm probability. However, when concentrated interference is present the modal detector is significantly superior. Figures 3; References 5: 2 Russian, 3 Western.

UDC 621.373.1

Specifics of Acoustoelectric Generation in Cadmium Sulfide

917K0021H Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 9, Sep 90 pp 1988-1994

[Article by V. V. Stefko]

[Abstract] An attempt is made, based on experimental studies of a large number of acoustoelectric generators, to determine the basic specifics of operation of these generators in order to obtain more precise and unambiguous knowledge concerning the capabilities for acoustoelectric generation of body acoustic waves in semiconducting piezoelectric materials. Studies were performed on generators consisting of plane-parallel plates of single-crystal cadmium sulfide 70 to 600 μm thick to operating modes of the generators were observed, including a transient mode. The influence of mounting conditions of the active element and the type of contact applied to the polished reflecting surfaces were studied. The generators can operate successfully in both pulse and continuous modes. All of the contradictory reports concerning the capabilities and features of operation of these generators have been based on experimental studies performed in the transient modes. The existence of nontransient operating modes indicates that these generators can generate oscillations at preprogrammed frequencies selected by the power supply voltage. Particularly interesting for practical use and experimental study are generators with active elements having injection contacts on their reflecting surfaces. Figures 4; References 10: 5 Russian, 5 Western.

UDC 621.396.962

Moving Target Indication and Restoration of True Position in Synthetic Aperture Radar With Arbitrary Platform Movement

917K006A Moscow RADIOTEKHNIKA in Russian No 8, Aug 90 pp 3-6

[Article by N. A. Sazonov]

[Abstract] The purpose of this study was to obtain and analyze algorithms for moving target indication and determination of the true position of moving targets in a synthetic-aperture radar with digital signal processing and arbitrary flight of the radar platform. The results obtained were verified by modeling digital signal processing on a computer. A good radar image, moving target indication and effective restoration of the true

position of the moving target are obtained with a ratio of signal to noise power of over 10 at the input of the digital signal processing system, with an error of not over 1.5 resolution elements or $1.5 \cdot 10^{-4}$ rad. Error increases rapidly with decreasing signal/noise ratio. Figures 2; References: 4 Russian.

UDC 621.37/39

Elements of Radiosystem Vector Optimization Theory

[Article by B. I. Kuzmin and Yu. S. Rusin]

[Abstract] A study is made of the basic theoretical prerequisites of solution of the problem of multistage vector optimization of an electronic system. The methods of vector optimization suggested allow comparatively simple computer procedures to be used to solve the problem of comparing alternative versions of the design or use of an electronic system, allowing a well-founded selection of the best version. In the examples studied it is assumed that the parameters of the alternatives compared are of equal value. A reference is given to another article by the same author in which a means is presented for considering the weighting of the parameters analyzed. Figure: 1; References: 6 Russian.

UDC 621.371.332.3

Recovery of Doppler Radar Data With Two Pulse Sampling Frequencies

[Article by V. M. Melnikov]

[Abstract] A study is made of the recovery of the power of a signal and its spectral moments out to a range exceeding the maximum measurement range R_m by performing measurements at two pulse-repetition frequencies. The maximum potential range is the sum of the measurement ranges provided by the two different pulse-repetition frequencies. A real-time recovery algorithm is suggested. The simple algorithm utilizes only subtraction of signal powers measured at the two repetition frequencies. Figures 2; References 7: 3 Russian, 4 Western.

UDC 621.396.967:629.735.33

Assuring Azimuthal Resolution of Synthetic-Aperture Radar Forming Radar Image of Flight Vehicles

[Article by A. I. Alekseyev, A. S. Kuznetsov and V. D. Novak]

[Abstract] Methods are suggested for compensating the influence of natural angular movements and the dimensions of the target flight vehicle on the process of generating a radar image. The specifics of functioning of a synthetic-aperture radar in external coherence mode are discussed. Results are presented from mathematical modeling of an azimuthal row of a radar image of a flying target. The two-stage algorithm suggested can maintain constant detail of the final image, convenient for subsequent automatic processing, and can operate at fixed frequencies. The method requires redundant frequency and time sampling of signals and synchronization of three carrier frequencies. Figures 2; References: 5 Russian.

UDC 621.391.26:621.396.96

Measurement of Complex Object Coordinates in Diversity Radio Systems

[Article by N. A. Potapov]

[Abstract] A quasioptimal algorithm is synthesized for interpositional processing of fluctuating signals from complex objects with compensation for noise correlated as to receiving position from several powerful sources in multiposition systems with separation of signal processing into intra- and interpositional processing and analysis of accuracy of object coordinate measurements. The probability density of the error vector of object coordinate measurement is determined. References: 6 Russian.

UDC 621.396.969

Increasing Range Measurement Accuracy by Parametric Identification of Measurement Channels

[Article by P. B. Petrenko and B. A. Stryukov]

[Abstract] A method is developed to increase the accuracy of multiple-scale phase-measurement systems exposed to multiplicative noise which changes slowly over time and leads to systematic errors in range measurements. It is demonstrated that the influence of mutiplicative noise of this type can be eliminated by the use of algorithms to identify the parameters of the system transceiver channel and the range to the target. The algorithms are based on the method of supplementary systems and can be implemented without changing the structure of the signal or the multiple-scale phase-measurement system hardware, by simply improving the software. References 6: 5 Russian, 1 Western.

UDC 621.391

Optimal Strategies in a Signal Identification Game

[Article by V. P. Ilatov and V. D. Platonov]

[Abstract] One problem solved using the apparatus of game theory is optimization of the strategy of two opponen.s—an electronic system and a jammer. In many studies the quality of functioning of the electronic system has been evaluated simply on the basis of the signal/noise ratio. The purpose of this article is to optimize the strategies of the jammer and the electronic system without this simplification, in which the purpose of the jammer is effective interdiction of operation of the electronic system, which must transmit and receive opposite signals. Effective suppression of the electronic system involves making it impossible to distinguish between the two opposite signals at the receiving end. The optimal strategy of the electronic system is matched filtration of signals randomly selected from a certain set according to a probability measure assuring noncorrelation and constant mean power of the signal components. References: 6 Russian.

UDC 621.396.67.012.12

Method of Increasing Antenna Characteristic Measurement Accuracy

[Article by R. I. Rumyantsev]

[Abstract] A solution is presented to the problem of reducing the influence of reflected signals in measurement of the external characteristics of an antenna in an open test area. A two-stage measurement procedure is suggested involving the use of a shield of radio absorbing material. The method suggested can increase the accuracy of measurement of such antenna characteristics as the radiation pattern. It does not require the use of expensive equipment or a special shape of measurement path. The method is, however, relatively insensitive in the sector of angles covered by the shadow of the shield, and the accuracy is limited by the influence of diffraction on the edges of the shield. Figure 1; References 3: 2 Russian, 1 Western.

UDC 681.7.068

Use of Rayleigh Scattering in Circular System to Record External Effects

[Article by I. K. Polyakova, A. A. Sokolovskiy and A. V. Sokolov]

[Abstract] A study is made of the possibility of accumulating changes in a Rayleigh scattering signal with weak actions on an optical fiber by repeated transmission of a probing pulse in a closed circular system. As the light pulse passes many times through a segment with induced losses it becomes possible to record weaker effects in the circular light guide than when traditional reflection methods are used. Calculation of the Rayleigh scattering signal and analysis of the influence of the external effect on it indicate the possibility of increasing the sensitivity of the system to small effects in optical fibers. Figures 3; References: 1 Western.

The First Fiber-Optic Communications Link in Railway Transport

[Article by V.V. Korennikov, V.N. Nuprik, V.V. Shmytinskiy]

[Abstract] The construction and operation of the first fiber-optic communications link in domestic railway transport (a 110 kilometer section on the Oktyabrskaya Railroad put on-line in 1985) are used as the basis for a survey of the principles of fiber-optic communications for application to railway transport. The specific equipment complement and station configuration of this first link are outlined in detail. Such elements as the number of attended and unattended repeater stations, types of cables, data transmission rates and techniques, etc. are examined. The completed link has been operated reliably and successfully for over a three-year period.

Magnetohydrodynamic Phase-Sensitive Relay

[Article by P. A. Burykin, V. A. Nazarenko]

[Abstract] The development of a new magnetohydrodynamic (MHD) phase-sensitive relay for use on railroad lines is reported. This device consists of an MHD switch containing a conductive fluid; a matching transformer and an electromagnet. The primary winding of the matching transformer is connected to the rail line, while the secondary winding is connected to the electrodes of the MHD-switch. The interaction of the current flowing through the conduction fluid and the magnetic field of the electromagnet produces an electromagnetic force and a corresponding pressure on the activation chamber. Tests on this relay have indicated that it operates stably under changing external conditions. The lack of a large number of moving parts enhances the overall reliability of the unit. A plot of the amplitude-phase response of the device is given together with its performance specifications.

Problems of Developing Dispatcher Control Concentration Systems

[Article by Yu. A. Odnopozov]

[Abstract] Recommendations on the incorporation of future dispatcher control concentration systems in an overall automation system for railway transport are given. These recommendations include utilizing line station code control subsystems in the control system equipment configuration to make it possible to transmit control commands from the railroad dispatcher or regional center, and to monitor the implementation of routing commands and train conditions at stations and adjacent spans. It is also recommended that an interface be designed and developed for installation between the electrical centralization system and the control and information signal transmission system used to transmit signals between the dispatcher center and the station. A compact, universal and multifunctional interface would be desirable, e.g. one that would replace the route relay rack and provide additional switch closure.

Remote Control System For the Automatic Locomotive Signalling Loop Code Generator Circuit

[Article by A. N. Anisimov]

[Abstract] The design and layout of the remote control system that employs standard mobile radio sets to control code transmission on automatic locomotive signalling test loops in railway transport are discussed. A breakout of the code combinations used in this system is given, together with an overall system block diagram and a schematic of the system encoder. A component-level analysis is carried out on the encoder and decoder as well as their subunits. Schematics of the timing, decoder, message test, control and display and auxiliary subunits are provided.

Tuning and Alignment of the Third-Modification RIS-V2 Radar Velocimeters

[Article by N. N. Kolesnichenko, M. A. Smychek]

[Abstract] The step-by-step tuning and alignment procedure for the third-modification RIS-V2 radar velocimeters is outlined. The requisite instrumentation for this procedure is specified (S1- 117 oscilloscope; G3-110 generator; V7-27 voltmeter; Ch3-33 frequency meter, Shch4313 tester and the TU16-517,216-6⁰ autotransformer). The first unit aligned in the system is the converter unit, with alignment involving trimming of resistors R3 and R6 as well as capacitors C4 and C6. Other units adjusted in this procedure include the stabilizer, the velocimeter and the threshold sensitivity control unit. Tables indicating specific component value settings are given. An external view of the testing set-up is provided together with timing diagrams and oscilloscope plots of proper adjusted pulse waveforms.

UDC 621.313.003

Simplified Mathematical Model of Earth as Unipolar Machine

[Article by I. P. Kopylov]

[Abstract] Apparently, the total power production of nuclear plants will stabilize at 10-15 percent of all power production. This will lend further urgency to the search for nontraditional, nonpolluting sources of electric power. The use of the energy represented by the magnetic field of the earth as a source of electric power is justified and demands the attention of the specialists. This article presents a description of the electromechanics of the planet, based on two electrical machines: an MHD generator converting the mechanical energy of cosmic particles to the electrical energy of the radiation belts and currents in the core of the earth and a unipolar machine, the rotor of which is the liquid magma. These two machines are joined by the magnetic field of the earth and form a unipolar electrical machine—the planet earth. Most promising is the possibility of industrial use of electric power using as its source the terrestrial magnetic field. One possible means might be connection of an artificial circuit in parallel to the transverse current circuit by the use of extremely deep wells. Artificial circuits on the surface of the planet could gain induced power due to the constant variations of the magnetic field. Other possibilities include utilization of the power embodied in ocean currents. Figures 6; References: 3 Russian.

UDC 681.51:629.439

Electromagnetic Suspension Control System With Fixed Gap Adjustment Circuit

[Article by A. I. Manikhin, M. M. Savin, Yu. A. Nikitenko and N. A. Rezhko]

[Abstract] A system is suggested for controlling the gap between the electromagnet and track in a magnetic levitation train system, based on the use of a main supporting winding and a smaller and variable control winding. Separation of the major suspension function from the control function allows more rapid changes of lift in order to maintain the desired maglev clearance. According to the design suggested, the main supporting current could be changed with payload, thus potentially saving up to 25 percent of the electric power cost of maglev train operation. Figures 4; References 2: 1 Russian, 1 German.

UDC 629.439:621.313-17.12

Increasing Effectiveness of Linear Asynchronous Traction Drive

[Article by A. P. Yepifanov, A. M. Lebedev and I. I. Talya]

[Abstract] The traction and power characteristics of magnetic levitation trains are inferior to those of rotating-wheel machines, particularly for high-speed use where larger air gaps are required. The traction and power characteristics of linear asynchronous thrust motors can be improved by modular configuration of the drive. This article presents results of an experimental study of the traction achieved by a motor consisting of two inductors placed in sequence and a reaction disk connected to a dc loading machine. A three-dimensional mathematical model is developed and a method suggested for calculation of the operating characteristics of linear asynchronous motors with modular inductor. Efficient selection of the pole division, inductor width, gap and parameters of the secondary element make the modular configuration economically much more promising. Figures 4; References: 10 Russian.

UDC 681.513.1:621.313.14

Study of Dynamics of Transverse Stabilization System of Multipoint Magnetic Suspension Model

[Article by Yu. V. Nekrasov, G. S. Galikyan, O. N. Pyatina and A. P. Katsupeyev]

[Abstract] A mathematical model and results of analysis of transient processes are presented in an automatic transverse stabilization control system tested on a linear test stand for the most typical cases of perturbed motion in the horizontal plane. The linear induction motor was rigidly attached to the carriage model. The concept of controlling the end pairs of the motor and a computer modeling method are studied. It is concluded that perturbations cannot be damped without an active stabilization system. Control of the end pairs of motors can achieve good quality characteristics at up to 250 km/hr while decreasing power consumption by an order of magnitude and control system hardware costs by a factor of 5. Figures 2; References: 5 Russian.

Fiber-Optic Power Sources

[Article by I. G. Kirin]

[Abstract] A wide variety of power supply system designs and configurations employing optical fibers are discussed; these systems are used to deliver luminous power to remote facilities and plants with the light converted into electricity at the terminal end. Schematics of the power converter hook-ups, the fiber-optic cable lines and the lens spacing and layout are given. The radiation sources in these systems include a variety of xenon and halogen lamps (the DKs, KGM and KIM series designs) as well as carbon dioxide and YAG:Nd(3+) lasers. The radiation wavelengths and power output levels of these lasers are reported. Spectral sensitivity curves of the radiation converters are given together with plots indicating the spectral responses of the optical fibers and bundles. Limiting factors such as surface damage to the optical fiber ends, electron emission and material breakdown in the constituent elements are discussed.

Calculation of Isothermal Aging of Cables With Dual-Layer PVC Plastic Compound Insulation

[Article by V. O. Kryzhanovskiy, G. P. Kazanchyan]

[Abstract] A mathematical model that accurately describes the complex aging process in dual-layer cables (prototypes) employing PVC plastic compound insulation is developed. The analysis assumes that the primary cause of aging is the desorption of the plastic compound which is a function of two elementary processes: the diffusion of the plastic compound from the inner layer to the outer layer and the desorption of the compound from both layers neglecting diffusion from the first layer to the second. Expressions are derived for the diffusion and desorption processes between the two cable layers while the relevant desorption rate coefficients are given. Tests were also conducted on both single and dual layer cable prototypes to test the accuracy of the derived equations. Plots of the plastic compound concentration as a function of isothermal aging time are provided for the different cable designs. The mathematical model is found to be accurate in predicting isothermal aging at any plastic compound concentrations.

Insulation Preparation and Application Equipment For Transposed Superconducting Wire

[Article by V. P. Oshchepkov, V. V. Popov, A. N. Surkov, Ye. A. Ustinov, N. N. Chernyavskiy, A. G. Chuguev]

[Abstract] Equipment designed for preparation and application of insulation onto transposed superconducting wire under industrial manufacturing conditions is discussed. The insulation material used for such wire includes polyimide and glasswool tape impregnated with EK-5 epoxy compound. The method of application involves impregnation of continuously moving tape with the resin. Block diagrams of the glasswool tape impregnation unit and the insulation applicator are given. Digital servo systems are used to control the insulation application rate while the feed unit is controlled by wire tension. Performance specifications are provided for the equipment discussed.

Effect of Powder Materials on the Size of Mineral-Insulated Cables

[Article by Yu. V. Rybakov, A. A. Frolov]

[Abstract] The compressibility of powder in mineral-insulated cables is investigated as a function of granulometric composition, presence of impurities, interparticle friction and other factors. Also analyzed is the friction in the metal-powder pairs in cables since friction between the powder and conductors affects insulation slippage from high-density regions to low-density regions. The following electrical periklase brands were analyzed: Dynatherm- 1240; PE-1M (domestic) and KMAO-N. Gadolinium, samarium, erbium and aluminum oxide powders were also analyzed. The layouts used to study the friction between the powder oxides and metallic surfaces of the cables are provided. The insulation properties were found to have a significant effect on cable strain. The differences in mechanical properties of the oxides are important and changes in cable size must be taken into account when different periklase brands are used.

Determination of the Demagnetization Coefficients of Hollow Ferromagnetic and Weakly-Ferromagnetic Elements

[Article by N. D. Bogacheva, V. V. Ivanov]

[Abstract] A theoretical analysis is carried out on the magnetic noise level generated by hollow ferromagnetic and weakly-ferromagnetic elements and its effect on the performance and operation of radio equipment. The analysis focuses on deriving expressions for the dipole magnetic moment of the magnetization source, for which various ellipsoids (oblate and prolate spheroids of revolution, spheres, infinitely long cylinders) are used. A table of the experimental demagnetization coefficients for the various hollow cylinders considered is given together with graphs of both the experimental and theoretical demagnetization coefficients plotted as a function

of the field strength of the magnetizing field. The theoretical demagnetization coefficient was found to differ by one to twenty percent from the experimental demagnetization coef⁻ cient with this differential growing with increasing diameter-to-length ratio. This is attributed to the more uniform magnetization distribution at high diameter-to-length ratios.

UDC 531.089.6:781

Method of Protecting Accelerometer against Nonmeasurable Influences

[Article by L. A. Kolesnikova, M. M. Malgun, L. F. Skrypnikova, and M. D. Sobolev]

[Abstract] A method of protecting piezoelectric impact accelerometers against nonmeasurable influences and thus ensuring their greater accuracy is proposed, considering that a standard textolite gasket now recommended not only does not sufficiently lower the sensitivity of these instruments to mechanical deformation and especially so to high-frequency stray effects but also needs to be almost as thick as the instrument base so that the impact strength of its adhesive bonds becomes inadequate. As a more effective alternative has been proposed the Bruel & Kjoer model UA0559 mechanical filter, which includes a rubber gasket and requires a plasticized epoxy compound as adhesive, but mounting an accelerometer on such a filter was found to increase its transverse sensitivity and to lower its resistance to lateral impact. This drawback can be eliminated, with a cost reduction, by use of an organosilicon sealing compound such as VGO-1 silicone instead. Four possible configurations are considered. Direct mounting on the seal is quite effective for various impact tests. Mounting through an SKON-1 paper interlayer, covered on both sides with VGO-1 compound, ensures reliable electrical insulation with hardly any degradation of insensitivity and strength. Mounting on the VGO-1 seal through a rigid steel or titanium interlayer protects the accelerometer against nonmeasurable influences by virtue of the "multilayer structure" principle based on alternating soft plastic and hard rigid layers. Mounting on a VGO-1 seal through a specially prepared VGO-1 interlayer of a definite thickness is particularly effective as protection against null drift based on suppression of high-frequency stray effects. Such a composite mount can withstand temperatures from -40°C to +50°C and, with a 0.7 mm thick adhesive layer, accelerations up to +/-50,000 m/s². Figures 2; references 7.

UDC 534.647.014.5:621.3.088

Error of Measurement of Nonlinear Distortions in Electrodynamic Seismometers

[Article by E. M. Bromberg, A. Ye. Manokhin, and O. S. Maksumov]

[Abstract] Factory and in-service inspection of electrodynamic seismometers is analyzed for accuracy, most difficult being measurement of nonlinear distortions in these instruments on account of their smallness compared with nonlinear distortions in the vibration test stand. The systematic error of their measurement, which involves excitation of the seismometer coil with electric current and the accuracy of which depends on the impedance of this coil, is calculated by replacement of the seismometer with its electrical analog. The mechanical structure of the instrument is accordingly represented by an equivalent R_M- L_M-C_M parallel circuit behind an R_O- L_O series circuit representing the instrument coil. The magnitudes of those equivalent M-parameters depend on the coil displacement relative to the seismometer housing, this variable displacement being the main cause of nonlinear distortions. The seismometer coil is assumed to be excited with a harmonic (cosinusoidal) current of given amplitude and frequency over a certain period of time. Calculation based on conventional circuit theory yields expressions, in terms of voltages, for the coefficient of nonlinear distortions in a free seismometer and in one under load. A simple conversion of voltages into impedances then yields an expression for the difference representing the relative systematic measurement error due to impedance of the seismometer coil. Calculation of the measurement error is then extended to cover nonlinear voltage distortions in the auxiliary apparatus consisting of a phase shifter and a differential amplifier as well as a voltmeter and a phase meter. Figures 1; tables 1; references 3.

UDC 621.314.242.088.3

Ultimate Accuracy of Parametric Small-Current to Voltage Conversion

[Article by A. M. Dorman]

[Abstract] Parametric conversion of a small current into a voltage on the basis of the "constant charge" principle with use of a passive device is analyzed, a much higher accuracy being attainable by such a method than by methods based on the "bound charge" principle and always requiring an

active device. The optimum "constant charge" current-to-voltage converter must be a parametric one because, according to Nyquist's theorem applied to thermal noise, it should ideally contain only reactances and switches without any dissipative elements such as resistances. A converter is accordingly considered which consists of a paral. etric capacitor in the form of a varactor bridge between the current source and a load capacitor, with a control device connected between the two inner center points of the bridge. The load capacitor feeds its voltage to an operational amplifier whose output signals proceed through a gating circuit and then a low-pass filter to their final destination, the gating circuit synchronized with the varactor bridge through that control device. Such a converter operates periodically, each conversion cycle involving a charge storage on the parametric capacitor (switch across current source open - switch across load capacitor closed) followed by a charge transfer to the load capacitor (switch across current source closed - switch across load capacitor open). When the varactor bridge is connected in parallel between current source and load capacitor, a two-way switch before it and a two-way switch behind it are manipulated by the same control device. When the varactor bridge is connected in series between current source and load capacitor, then it inverts the output voltage and there is no place for two-way switches. Evaluation of the systematic conversion error, which involves analysis and calculation of charge and discharge noise, is in both cases based on the converter transfer function and its comparison with that of an ideal one. The random conversion error is evaluated in terms of noise current dispersion, and found to be smaller than that of a resistive converter with corrective noise filter. Figures 2; references 9.

UDC 621.317.328.089:621.396.47

Method of Certification Testing of Field-Strength Meters With Whip Antennas at Frequencies below 150 kHz

[Article by V.A. Tishchenko and V.I. Tokatly]

[Abstract] A method of certification testing of field-strength meters with whip antennas at frequencies covering the 30-150 kHz range and the necessary apparatus are described which require neither a high-voltage source to match the high capacitive antenna input impedance at low frequencies nor a reference-standard carrier antennas whose sensitivity inherently drops as the frequency drops. A capacitor with a ring electrode rather than plate electrode is being now used, but such an electrode must be large: 4 m in diameter 2.5 m above ground for a 1 m high whip antenna. The diameter can be reduced to about 1 m without exceeding a 1% measurement error, but the

antenna will then be located in a nonuniform electric field and this must be accounted for in the measurement. This is proposed to be done by determining the intensity of an equivalent uniform electric field which would generate the same voltage or current at the antenna output. This equivalent field intensity is calculated, considering that a whip antenna and its mirror image in an infinite plane form a dipole antenna. The apparatus necessary for certification testing on this basis includes a reflector, an extension piece for the whip antenna, a ring electrode with a transition, an oscillator, a voltmeter, and a field-strength reading instrument. The apparatus is tested on a spherical transmitter antenna by making measurements made at discrete points around it at discrete transmitter frequencies up to 150 kHz and subsequently certified on the basis of an accuracy analysis which includes the voltmeter error as well as the nonuniform-to-uniform field equivalence error. A test stand like this burdened with an overall error within +/- 13.2% is adequate for inspection and certification of whip antennas which measure the electric field intensity with a normalized error up to 41% or 3 dB. Figures 2; tables 1; references 10.

Inspection and Measurement Technology at Special INTERATOMKONTROL-89 Exhibit

[Article by S. S. Babayev and A. Sh. Sire]

[Abstract] At the Exhibition of of USSR Achievements in USSR National Economy from 22 June to 2 July 1989 a special 'Interatomkontrol-89' exhibit in the 'Electrification of the USSR' pavilion featured the MD7-500 microtron flaw detector built by the "Atommash" (Atomic Apparatus) Association along with various ultrasonic transducers for inspection of welded joints in thermal and nuclear power plants, including the ASK-132 for remote inspection through a television circuit in nuclear power plants. Other items of interest were the STU-6 stereoscopic television apparatus for remote control of robot manipulators and mechanisms inaccessible to a human operator, a whole gamut of dosimeters built by the "Isotop" Association along with the BDPN-1K neutron detector, the MKS-O1R1 universal (α- particles, β-particles, γ-rays, X-rays) radiometer-dosimeter, the RGB-07 gas (^{41}Ar, ^{85}Kr, ^{133}Xe, ^{14}C (CO_2), ^3H) activity radiometer, the DRG-O1T1 dosimeter with gas-discharge tube counters as well as the the DRG-05 γ-ray and X-ray dosimeter with β-particle indication, the RZB-05 contamination level indicator with threshold-level alarm built by the All-Union "Tekhsnabeksport" (Technical Equipment for Export) Association, and the SPSS-02 α,β,γ pulse count rate indicator with threshold-level alarm. Foreign exhibitors included the Czechoslovak Institute of Measurement Technology, ISPE Enterprise (Romania), Singer Co (USA), "Inspectronique" Cie (France), Bruel & Kjoer Co (Denmark), Siemens GmbH (Germany), and Olympus Co (Japan).

New Communications Cable

[Article by A. S. Vorontsov, Central Scientific Research
Institute of Communications and L. Ye. Kondratyeva,
Moskabel Plant, F. F. Nizametdinova, Design Engineer]

[Abstract] The authors' organizations have developed a
new balanced high-frequency communications cable
with cordel-polystyrene insulation. The new cable has
three and one-half times greater protection from light-
ning damage than MKSA cable, with an expanded fre-
quency band. The design of the cable is diagrammed and
its technical specifications are listed. The cable can be
installed by ordinary cable laying equipment according
to the existing recommendations and rules. The USSR
Ministry of Communications has recommended broad
utilization of lightning-resistant cable, intending com-
plete replacement of traditional MKS cable. Moskabel
plant has manufactured over 1500 km of the new cable.
Figure 1.

Prospects For HDTV

[Article by S. Zelenskaya]

[Abstract] In November of 1989 the International Elec-
trical Communications Committee announced the
results of a meeting of the International Consultative
Committee for Radio on analysis of problems in the area
of high definition television (HDTV)—Russian abbrevi-
ation TVVCh. The results of the work of the committee
were approved at a plenary assembly of the CCRI in
May, 1990. The history of development of the emerging
HDTV standard is briefly discussed, emphasizing the
contribution of Soviet scientists. Rapid introduction of
HDTV is planned for 1990-1994. No information is
presented on prospects for HDTV in the Soviet Union.

Soviet-French Cooperation in Communications

[Article by Ye. Borisov]

[Abstract] A symposium and exhibit entitled "France
and Communications Facilities" was held 24-27 April,
1990 at the International Trade Center, organized by the
USSR Communications Ministry and Francetelecom.
The changes in the foreign and domestic policies of the
USSR have allowed further improvement in relations
between France and the USSR, including events such as
this symposium, where Soviet specialists were familiar-
ized with the resources and facilities of Francetelecom.
Major advances in French telecommunications over the
past 15 years are emphasized, leading to the hope for
similar improvements in Soviet communications ser-
vices in the future.

Effect of Electron Bombardment on Characteristics of MOS Structures During Examination Under Scanning Electron Microscope

[Article by M. G. Kartamyshev, A. N. Nevzorov, A. L. Obukhov, S. Yu. Poroykov, and E. I. Rau, Moscow State University imeni M. V. Lomonosov]

[Abstract] The effect of electron bombardment on the characteristics of MOS structures during examination under a scanning electron electron microscope is analyzed, an experiment having been performed with standard MOS capacitors built on p-Si layers with an electrical resistivity of 1 ohm.cm in the initial state. These layers were held in an atmosphere of pure oxygen at 1050°C till up to 0.1 μm thick SiO_2 surface layer had formed, whereupon 1 μm thick Al-electrodes covering an area of 1 mm^2 were deposited on top. These structures where then annealed at 450°C for 40 min in a hydrogen atmosphere for subsequent examination under a scanning electron microscope with a 13 keV electrons in a beam carrying a current of 1 nA. The surface density of the electron dose, determined by the length of scanning time, was varied over the $2 \times 10^{12} - 2 \times 10^{13}$ range. The capacitance-voltage characteristics were measured with a 200 kHz high-frequency test signal. On the basis of these measurements were then evaluated the density of surface states and the change of voltage across the flat bands, both dependent on the bombardment dose, the voltage across these bands prior to electron bombardment being having been calculated by the Berglund method on the basis of quasi-static capacitance-voltage characteristics. The results together with known electron-paramagnetic-resonance data confirm that rupture of Si atomic bonds near the $Si\text{-}Si_O$ interface is what causes the density of "radiative" surface states to peak with a maximum near the center of the forbidden band. The analysis is extended to MOS-transistors and change of their threshold voltage under electron bombardment, then also to integrated circuits on MOS structures after passivation of the latter by the potential-contrast method and structural distortions subsequently caused by electron bombardment. The physical model most adequately explaining the effect of electron bombardment on such MOS structures is ionization of the passivation layer to some negative equilibrium potential and attendant relaxation of the potential contrast resulting in erasure of both positive and negative contrast "memories", the relaxation time depending on the duration of bombardment and on the energy of bombarding electrons. Emission of secondary electrons also plays an important role here. The contrast relaxation time increases exponentially with increasing duration of electron bombardment and increases slightly as the energy of bombarding electrons is increased, except for an anomalous dip of the relaxation time occurring within the 10-15 keV range of

electron energy. The thickness of the charged surface layer, meanwhile, is determined by the depth of secondary electron emission and can reach 0.1 μm in a scanning electron microscope. Figures 6; references 19.

Analysis of Playback Signal From Magnetoresistive Heads

[Article by S. Kh. Karpenkov, Moscow Institute of National Economy imeni G.V. Plekhanov]

[Abstract] The playback signal from magnetoresistive heads magnetically biased by appropriate orientation of the driving-current density vector j and accordingly having a positive structure with equally wide uniformly spaced conduction zones is analyzed, that vector being optimally oriented along those zones within in them and perpendicularly to those zones within the gaps between them. Assuming a given skew angle α of the conduction zones and a given angle θ between which the magnetization vector M forms with the longitudinal component j_x of the current density vector, the magnetoresistive component of the playback signal voltage under the conduction zones and across the gaps between them is calculated according to the Karpenkov $\Delta\rho.\cos^2\theta$ model of electrical resistivity ρ anisotropy. The galvanomagnetic component of the playback signal voltage across the gaps due to the planar Hall effect is calculated in the $\cos\alpha.\sin2\theta$ approximation and its thermomagnetic component, in the direction of the temperature gradient, is calculated in the $delT.\sin2\theta$ approximation. The results of these theoretical calculations are confirmed by experimental data ($\rho_0 = 20$ μohm.cm, $\delta\rho = 0.55$ μohm.cm, $\delta\rho/\rho = 0.025$, $j = 10^7$ A/cm^2, $\alpha = 45°$), indicating that the maximum sum of both galvanomagnetic and thermomagnetic components may amount to about 52% of the total playback signal voltage. Figures 4; references 12.

Feasibility of Circuit Integration Based on Junction Technology

[Article by N. K. Trubochkina, Moscow Institute of Electronic Machine Design]

[Abstract] A new circuit integration technology is described, its elementary component being a a bipolar junction between regions with different properties. For the purpose of computer-aided design, such a junction is simulated by a graph $G(X,A,\Gamma)$ where $X = (x_1,..., x_N)$ denotes the set of vertices and $A = (a_1,..., a_M)$ denotes the set of edges. Each vertex x_i represents a part of the circuit

structure $T_t(F_t)$, T_t defining the content of this part $T =$ $[T_t]_{i=1,N} = (p,n,p^+,n^-,...,SiO_2, ...,Al,Ga) = SUCDUM$ (S-subset of semiconductor regions, D- subset of dielectric regions, M- subset of metal regions) and F_i being an element of the functional set $F = F_y UF_d$. This set consists of two subsets: subset of external control actions $F_y=$ $(F_{yi}) = (E_1,...,E_{k1},I_1,..., I_{k2},\gamma_1,...,\gamma_{k3})$ (E- voltages, I- currents, γ- light) and subset of destinations $F_d = (F_{di})=$ $(in_i,...,in_m,out_1, ...,out_m)$ (in- inputs, out- outputs). The graphical models of integration elements can be trees and can include cycles, the simplest elements being: semiconductor (N= 1), diode (N= 2), transistor (N= 3), injection inverter (N= 4). While two-emitter and two-collector transistors are also represented by a graph with N= 4, an amplifier or follower is represented by a graph with N= 5 and a complementary bipolar inverter (a vertical one having the highest packing density) is represented by a graph with N= 6. The graphical models are converted into mathematical ones, namely into equations describing synthesis of circuit integration on a bipolar junctions as elemental base. The procedure is demonstrated on an injection inverter and on functionally integrated NAND and NOR gates, the two representing a functionally complete logic balance suitable for synthesis of any no matter how intricate combinatorial computer circuit. Five rules are established which cover synthesis including interconnections. This principle of synthesis from graphical models of is demonstrated on bipolar VLSI, an important problem being to minimize the number of semiconductor regions and the number of interconnections. Use of the bipolar-junction technology is shown to not only resolve the power problem by eliminating the power drain under static conditions but also yield integrated circuits with fewer semiconductor regions and fewer interconections than in their MOS-transistor analogs (TTL, ESL, I^2L) including even CMOS-transistor logic circuits. Figures 4; tables 3; references 7.

UDC 681.327

Memories With High-Speed Sequential Access and Data Output

[Article by S. V. Rotnov]

[Abstract] Memories with sequential access and digital data output are described which feature high-speed processing of pulse sequences at repetition rates up to several hundred MHz and conversion to several GHz operating frequencies. Their design and performance are analyzed, the basic version being an single-level economy memory built with series K1500IR141 shift registers. Next is considered a two-level memory with two shift registers in first-level memory and a standard random-access memory as second-level memory, operating in accordance with the standard or a special timing

diagram. In conclusion is considered a multilevel large-capacity memory, a typical one in the CMOS LSI version with a 32Kx8 bit structure drawing a power of less than 700 mW and readily built a 32Kx64 bit one. Figures 5; references 9.

UDC 628.325.6

Universal Digital Neurocomputer Module

[Article by S. O. Mrktchyan and T. P. Altunyan, Yerevan Polytechnic Institute]

[Abstract] Synthesis of a universal and yet simple digital module suitable for building multifunctional neuromputers and readily adaptable for circuit integration is proposed, on the basis of Mkrtchyan's mathematical model of a generalized formal neuron: $F= sgn(w_i a_i- \theta)$ from i= 1 to i= n, function sgn $\varphi= 0$ when $\varphi < 0$ and 1 when $\varphi \leq 0$ (w_i weight of i-th synaptic input). A one-to-one correspondence between the threshold diagram, rewritten in terms of Venn diagrams, and its output function F is established in the form: $F= V M_j sgn(\sigma_j - \varphi)$ from j= 0 to j= 2^δ- 1 (M_j) - j-th minterm of logic input variables (x_k, k= 1,...,δ, σ_j- total excitation (σ, j= 0,...,2^δ- 1, δ- number of functional inputs). A digital sequential comparator whose last stage puts out an a_j signal as a result of successive switching from place to the next and a digital multiplexer putting out an F signal are synthesized on the basis of this model. Figures 1; references 8.

UDC 535.8:535.241.13

Contactless Measurements of Electric Nanosecond Pulses

[Article by L. A. Angelova and L. N. Kravchenko]

[Abstract] Optical contactless measurement of electric nanosecond pulses and their waveform as they propagate through high-speed semiconductor devices and electronic microcircuits by using the linear electrooptic Pockels effect is proposed, this effect being based on polarization of electron shells and the main advantage of this method over conventional stroboscopy therefore being the much smaller sluggishness with a time lag not exceeding 10^{-4}. The apparatus for measuring the waveform of nanosecond pulses consists of a YAG:Nd^{3+} laser with active mode locking as source of probing light pulses, a beam-splitter plate, an avalanche photodiode, an electrical delay line, a pulse shaper, a modulator-oscillator, an optical delay line which consists of a total-reflection reversing prism and two plane mirrors, a

polarizer, a focusing microobjective stage, a compensator, an analyzer, a differential "slow" photodetector, a narrow-band amplifier, a synchronous detector with an analog-to-digital converter, a control computer, and a "common busbar" interface. The device or circuit is placed on the table of an XY-coordinate plotter under the microobjective so that it receives normally incident probing light pulses while it also receives electric input signals from the pulse shaper and sends electric output signals through a stroboscopic oscillograph to a recording instrument. The busbar interfaces the control computer with the recording instrument in the interactive mode and with the analog-to-digital converter behind the synchronous detector. In this apparatus one can obtain a periodic sequence of 100 ps probing light pulses at an about 110 MHz repetition rate and a synchronized with it sequence of electric pulses additionally modulated at a much lower frequency of about 30 kHz frequency. Figures 3; references 6.

UDC 548.732

Diagnostic X-Ray Examination of Multilayer Thin-Film Heterostructure on GaAs Substrate

[Article by A. L. Golovin, A. A. Stoskov, S. A. Stukalov, and U. Pitsh, Institute of Crystallography, USSR Academy of Sciences]

[Abstract] Combination of two methods, X-ray reflectometry and X-ray diffractometry with grazing incidence, is proposed for examination of multilayer thin-film heterojunctions. While X-ray diffractometry with grazing incidence is sensitive to variations of structural characteristics such as lattice parameters and degree amorphization, also to variations of surface roughness and thus indirectly of the refractive index, X-ray reflectometry in either integral or differential mode is sensitive to variations of optical characteristics and surface roughness as well. Both methods were combined with X-ray reflectometry first in the ir 'egral mode and then in the differential mode and with a DRON-2 X-ray diffractometer on a GUR-8 goniometer base. Data were processed by a CAMAC crate with an SM-4 minicomputer and an external storage. With this apparatus was examined $Ga_xAl_{1-x}As/GaAs$ structure, this structure having a total thickness of 142 nm and found to consist of 2 nm thick completely amorphous top layer containing 48% Al and five partly amorphous or completely crystalline layers underneath: 10 nm thick interlayer containing 33% Al, two 20 nm thick layers containing 24-25% Al, 10 nm thick interlayer containing 45% Al, and 80 nm thick bottom layer. The authors thank Professor R.M. Imamov for interest and helpful comments. Figures 4; tables 1; references 8.

UDC 621.382

Combination of Methods For Fabrication of Stencil Templates

[Article by K. A. Valiyev, L. V. Velikov, R. Kh. Makhmutov, S. N. Sidoruk, and V. S. Yakunin, Institute of Physics and Technology, USSR Academy of Sciences]

[Abstract] The feasibility of fabricating stencil templates or masks from 5-30 μm thick silicon membranes by a combination of anisotropic liquid-immersion etching and reactive ion-beam etching has been demonstrated on drawings depicting the topology of several microelectronic devices such as field-effect transistors with gates of submicrometer length, surface- acoustic-wave structures, and Josephson-effect structures. Anisotropic liquid-immersion etching can produce straight clearances less than 1 μm wide, while reactive ion-beam etching can produce elements of a master drawing of any shape and of size larger than 1 μm. Such a stencil template has been transferred onto a 0.6 μm thick layer of ELP-20 resist on a GaAs substrate and the microphotograph of a single drawing element with a 0.15-0.2 μm wide clearance is shown for illustration. Figures 3; references 8.

Analysis of Variants For Converting the Armenian Nuclear Power Plant into a Nonnuclear Thermal Power Plant

[Article by V. A. Ivanov, V. M. Borovkov, A. A. Kanaev, I. Z. Kopi]

[Abstract] The broad range of possible design modifications and alternative approaches to research and development aimed at the most comprehensive possible utilization of nonnuclear power equipment installed at the Armenian nuclear power plant are considered in this preliminary analysis of problem. The primary goal is to bring the plant on-line as a nonnuclear facility by utilizing all possible nonnuclear (nonreactor) components. The heat recovery system used with the VVER-440 reactor unit and the K-220-44/3000 turbine generating sets is analyzed and alternative power sources are considered, including steam generation, organic-fuel-fired and natural-gas fired turbines as well as solar-powered designs. It is determined that the nonnuclear systems at the power plant have an additional service life of fifteen to twenty years, and the best alternative energy sources include a mixture of liquid and gas fuels and solar energy. It is recommended that these modifications be introduced without substantially modifying the heat-recovery systems or designs.

Determination of Hydraulic Losses From a Two-Phase Flow in a Horizontal Pipeline

[Article by V. I. Timoshenko, Yu. V. Knyshenko, V. I. Shcherbakov]

[Abstract] The combinations of determinant parameters that would reduce the number of independent parameters in calculating hydrualic losses from two-phase flows in horizontal pipelines are sought. A survey of empirical relations derived by various authors for calculating hydraulic pressure and their application conditions is provided. It is determined that the Reynold's number of a two-phase flow, which is a function of a majority of the determinant parameters, can be used as a generalizing parameter. This Reynold's numbers can be employed to compare the applicability of empirical relations derived by various authors for determining the hydraulic pressure of horizontal pipelines.

UDC 621.311.25:621.1.039.004.65

Eliminating Chernobyl's Aftereffects

[Article by Ye. I. Ignatenko, Atomenergoproyekt]

[Abstract] An analysis is presented of the causes, including design defects and improper personnel actions, leading to the Chernobyl nuclear power plant disaster. Design changes which have been undertaken on other reactors of the same type are listed. The tremendous complex of operations undertaken immediately after the disaster and continuing today to eliminate its after effects is described. These operations include the immediate work undertaken to halt further radioactive emissions, continued monitoring of the radiation status, decontamination of the area, localization of the contaminated zone, disposal of radioactive wastes, evacuation of over 115,000 persons from the contaminated area to 13,000 new residences in 50 new villages, 8,000 apartments in Kiev and Chernigov, and provision of jobs for all those evacuated. The new city of Slavutich has been constructed for the employees of the power plant, which is now back in operation. The major present economic activity in the 30 km zone is support of the operation of the power plant, plus scientific study of the aftereffects of the disaster.

UDC 621.316.37.027.8-742(084.2)

Concerning I. I. Pribylov's Article "New 220-1150 kV Outdoor-Type Power Distribution Units"

[Article by B. N. Neklepayev and Yu. V. Bakov, Moscow Institute of Power Engineering]

[Abstract] This article reviews another article which discusses the need to develop new, more reliable, economical and easier-to-operate outdoor-type distribution units for power plants and substations. The original article did not present the specifications of a distribution unit which was described in the article for the first time. The advantages and disadvantages of the new system are discussed. Figures 5; References: 2 Russian.

Discharge Characteristics of Insulation Support Structures For Ultrahigh Pressure Network Leakage Relays

[Article by G. N. Aleksandrov, V. L. Ivanov, A. I. Afanasev]

[Abstract] The use of highly-placed supports that increase the electrical field strength at the grounded baseof an insulation structure to equalize the voltage distribution through the insulation of power distribution networks and thereby increase its electrical strength is considered. The study was carried out on an outdoor test stand with a seven megawatt, 560 kilojoule pulsed generator and a 3X750 kilovolt, two amp test transformer stage used as the pulse sources. The electrical strength of the support insulation was tested on a prototype insulation structure. Curves indicating the performance of the insulation systems for various voltage surge pulse waveforms are provided. The pulse waveforms were found to have a significant effect on the maximum height of the supports. When modern porcelain insulators are used for the support insulation on highly-placed supports, the analysis reveals that no severe limiting of switching voltage surges is required.

Increasing the Specific Power Switched By a Magnetic Compression Section

[Article by N. P. Polyakov, V. V. Sinenko]

[Abstract] Techniques for substantially increasing the specific power switched by a magnetic compression section by altering the operating conditions of the section are considered. A schematic of the compression section is provided and relations are derived for the saturation conditions and inductance levels of the magnetic compression section under analysis. The possibility of using a "premature" saturation state is considered and systems of linear differential equations are obtained to describe the transient processes in the circuits in such a case. Oscilloscope traces of the switching current pulse waveforms are given together with plots of the residual power as a function of specific switched power for various compression coefficients. The "premature" saturation ate is found to make possible a substantial increase in the specific power switched by the compression section.

The Features of Electrode Erosion Under Megavolt Heavy-Current Discharge in Sulfur Hexafluoride Gas

[Article by A. Z. Nemirovskiy, Yu. F. Potalitsyn, A. A. Starobinets]

[Abstract] The unusual nature of brass and stainless steel electrode erosion in sulfur hexafluoride gas in the central discharge zone of megavolt spark-gaps is investigated under experimental conditions. The study assumes that the majority of material loss occurs in this region. A switching test stand is used in the experimental analysis; this unit consists of a water- cooled pulse shaping line with a two-way pulse propagation time of 100 nanoseconds and a wave impedance of 5.3 ohms. The test spark gap produced a decaying pulse with an oscillation period of 200 nanoseconds, a ratio of neighboring maxima of 1.2 and a first maximum amplitude of 150-400 kiloamps. A theoretical model was also developed to determine the characteristic time scale over which current is concentrated near the cathode surface where damage occurs and to analyze the Joulean heat source in the skin layer. It is determined that the nature of the additional material loss in the erosion trace is satisfactorily explained by the presence of an intense Joulean energy source in the skin-layer on the cathode surface.

New Electrical Engineering Textbook

[Article by O. P. Mikhailov]

[Abstract] The new electrical engineering textbook by S. Yu. Masyokas recently published by the Mokslas Publishing House (in Lithuanian) is reviewed. This text is designed for nonspecialist students of electrical engineering at institutions of higher education for use in the course entitled "Electrical Engineering and the Principles of Electronics". The text is heavily illustrated and makes extensive use of schematics and diagrams of electrical systems, equipment, devices and components. Full treatment is given to electrical engines and generators, machines and equipment. Among the drawbacks of the book is no discussion of computer-aided design, neglect of matrix equations used in circuit topology design, and no discussion of other modern methods of circuit analysis.

UDC 621.31

Improvement of Shielding Apparatus For Repairs Under 330-750 kV Voltage

[Article by O. I. Kulmatitskiy, engineer, Economic Planning Department, 'Vinnitsaenergo' (Vinnitsa Regional Administration of Power System Management]

[Abstract] Since a great deal of repair work along the 330-750 kV overhead transmission lines of the Vinnitsa Regional Power System was found to be required since their installation in 1983 and since such work is being done under voltage, there is a need for reliable shielding to ensure safety of the maintenance crew during replacement of defective insulators, spreaders, or other parts. The problem is analyzed in accordance with transmission-line theory, on the basis of extensive measurements at the repair sites and simulation tests on a Standard System 2030 computer, spark discharge from conductor to pole brace being of main concern. The results of subsequent tests performed on a laboratory model duplicating real sparkover in terms of specific discharge power, capacitive current, and breakdown voltage indicate what the requirements for adequate shielding are. Four materials for a protective suit were tested: 1) cloth made of KEN complex conducting thread, 2) cloth made of KEN thread and silver-coated copper thread, 3) linen interwoven with 2% silver-coated copper thread and threads of cotton-paper yarn laid parallel to it so as to facilitate formation of a cage, 4) cloth made of bronze thread and viscose yarn twisted together. On the basis of the requirement that there be no burned or charred spots in the material after sparkover lasting for a period of 3 min, cloth made of 2% silver-coated bronze thread and parallel to it natural fibers rates as the best material for protective suits. Such suits must be designed to take into account wear and tear. Its is still desirable to lower the electric field intensity at the repair sites by any available means. Figures 2; tables 1; references 4.

UDC 621.315

Reliability Characteristics of Reinforced-Concrete Tower Bases for 750 kV Overhead Power Transmission Lines

[Article by P.I. Romanov, candidate of technical sciences, Northwestern Department, 'Energosetproyekt' (Power Network Design), and V.G. Momot, engineer, Economic Planning Department, 'Dneproenergo' (Dnepropetrovsk Regional Administration of Power System Management)]

[Abstract] Since total of 190 intermediate towers along three 750 kV power transmission lines in the Dnepropetrovsk region had been mounted on reinforced-concrete bases, those along the Dnepropetrovsk - Zaporozhye line and along the Donets Basin - Zaporozhye line were tested in October 1987 for reliability. The results of these tests, together with data collected over the entire service period, indicate a high mechanical stability of these structures and a uniform compressive strength of the material in accordance with with the design criteria. These characteristics justify the high operating cost and maintenance cost of the 750 kV power transmission lines. Continued regular inspection is necessary, however, and improvements facilitating it are called for. Better rigging of 28-32 m high ladders will be necessary for safe and thorough inspection under voltage so that much more costly shutdowns can be eliminated. New structures must be designed better so as to meet increasingly severe service requirements. Figures 1.

UDC 621.31

Model of Rural Electrical Network For Quantitative Analysis of Electricity Supply to Users

[Article by P. P. Feshchenko, engineer, UkSSR Ministry or Energy]

[Abstract] A physical model of a rural electrical user network is proposed for quantitative reliability and cost analysis of an external electrical power supply system. This model represents a power system consisting one or two 35 kV overhead transmission lines, 35/10 kV transformer substations, 10 kV overhead transmission lines, 10/0.4 kV transformer substations, and users connected directly to busbars. In three variants there are users connected to all three 35 kV, 10 kV, 0.4 kV busbars. In one variant there are users connected to the high-voltage 35 kV and 10 kV busbars but none connected to 400 V busbars. Two criteria have been found to be necessary and sufficient for a quite thorough evaluation of reliability improvements and their cost. These are, respectively, the relative undersupply of electric energy and the relative specific cost of reliability assurance. The mathematical model for performance analysis of rural power networks in the UkSSR is applied to 15 possible combinations of the four variants. The results of calculations based on routine and emergency shutdown statistics and on a 0.75 ruble/kW.h unit cost of averting energy supply deficiency, this figure having been arrived at by the Scientific and Technical Council at the USSR Ministry of Energy, indicate quite reliably that the optimum combination is two 35 kV overhead lines + two 35/10 kV transformer substations with automatic standby switching on both sides + two 10 kV overhead lines + one 10/0.4 kV transformer substation. They also indicate

that providing enclosed 10/0.4 kV transformer substa-
tions for certain categories of rural electric power users
in the UkSSR is not economically justified. Figures 2;
tables 6; references 3.

UDC 62-68.003.1

Outlook For Utilization of Secondary Energy Sources in UkSSR Industry

*907K0288D ENERGETIKA I ELEKTRIFIKATSIYA
in Russian No 2, Apr-Jun 90 pp 36-39*

[Article by S. P. Sushon, candidate of technical sciences,
and A. G. Zavalko, candidate of technical sciences,
Ukrainian Scientific Research Institute of Planning and
Standards]

[Abstract] Considering the difficulties associated with
utilization of secondary energy sources in industry, as
weighed against the advantage of resulting fuel conser-
vation, the outlook for their utilization in the most
fuel-intensive sectors of the UkSSR industry is examined
on the basis of the latest fuel consumption status and
trends. These sectors are ferrous metallurgy, petroleum
processing and production of petrochemicals, produc-
tion of chemicals, production of mineral fertilizers, gas
and steam production, manufacture of machinery, and
production of structural materials. The principal sec-
ondary energy source in these industries are flue gases
and the major obstacles to a more extensive utilization of
their heat are not only their low caloric value and lack of
adequate equipment for their retrieval and delivery, flue
gases being difficult to transport and most of them being
aggressive, but also the seasonal demand and relatively
low demand usually not coincident with their avail-
ability. There are also problems of organization and
intersectoral coordination. As conditions change, how-
ever, in the UkSSR utilization of secondary thermal
energy sources is expected to increase from 56.6% in
1990 (31 million Gcal) to 62%.

UDC 621.9

Outlook for Development of Nontraditional Power Technology in UkSSR

*907K0288E Kiev ENERGETIKA I
ELEKTRIFIKATSIYA in Russian No 2, Apr-Jun 90
pp 41-43*

[Article by V. F. Reztsov, doctor of technical sciences, L.
P. Fedosenko, candidate of technical sciences, O. G.
Denisenko, candidate of technical sciences, and S. V.
Margalik, candidate of technical sciences, Institute of
Electrodynamics, UkSSR Academy of Sciences]

[Abstract] The demand for and the cost of utilizing
renewable energy sources, namely wind and solar radia-
tion, in the UkSSR over the 1995-2000-2005 period is
estimated on the basis of demographic projections and
economic indicators including the variable availability
of these source and the ecological effect of effect of
replacing conventional fuels. The estimates cover three
regional power systems in which utilization of these
energy sources would be most cost effective: 1) southern
part of Dnepropetrovsk - Donets Basin - Zaporozhye
system, 2) Transcarpathia - Kirovograd - Nikolayev -
Odessa - Kherson system, 3) Crimea regional system.
They also cover both Lvov and Kharkov regional power
systems. Adding these sources of the overall fuel-
and-energy balance in the UkSSR is expected not only to
save annually 247.9 thousand tons of standard fuel
costing 14.6 million rubles but also to prevent 2.2
million rubles worth of ecological damage to the envi-
ronment annually at the year 2005 level of energy
consumption. Tables 8; references 7.

UDC 621.315

Technology of Installing Towers for 500 kV Overhead Line Across Tanguysk Bay

*907K0274A Moscow ENERGETICHESKOYE
STROITELSTVO in Russian No 4, Apr 90 pp 52-55*

[Article by P. S. Zhutorskov, engineer, G. P. Lebedev,
engineer, and V. A. Kolesnikov, engineer]

[Abstract] Engineers in the Department of Long-
Distance Power Transmission at the "Energosetproyekt"
(Power Network Design) Institute have developed a
technology of installing PP500-1/76 towers according to
the K-P- P-K scheme for 500 kV overhead power trans-
mission lines across the Tanguysk Bay between the
Bratsk switching station to the Novoziminsk substation.
The basic concept is to assemble the tower in horizontal
position on the ground and then to raise the complete
structure into upright position by rotating it about a
hinge fixture, this procedure having been successfully
followed earlier in the installation of towers for the 750
kV overhead power transmission lines across the Volga
River between the Kalinin AES and the Vladimir sub-
station. Each tower is 88 m tall and weighs 170 t, with a
14.4 m wide square base and with the center of gravity
40.5 m above ground designed for it to stand freely
without lateral supports. Two cross-arms at 76 m and 88
m above ground respectively are installed for tying the
conductors of the two outer phases and the lightning
arrester cables. The equipment for installation of such a
tower includes two drawing block-and- tackles, two
mounting posts, one restraining block-and-tackle, two
pull mechanisms, two post lowering ropes, two lateral
braces, two diverting pulleys, two supporting pulleys,
and two pulling anchors. Figures 1.

UDC 622.233

Drilling Horizontal Ducts Through Sticky Rock Instead of Digging Trenches For Installation of Engineering Canalization Conduits

[Article by L. Ye. Mametyev, candidate of technical sciences, A. N. Ananyev, engineer, S. M. Karpenko, engineer, and I. A. Tsvetnitskiy, engineer]

[Abstract] A new method of drilling ducts through sticky rock has been developed at the Kuznetsk Basin Polytechnic Institute which avoids buildup of sticky soil on the tool bit and is more energy efficient than conventional drilling. This is accomplished by pouring water through the drive pipe onto the flutes at the tip of the augur facing the wall until the consistency of the adhering soil has been reduced to fluidity level. The necessary equipment consists of a BRA-4 horizontal drilling machine mounted on a frame with an augur inside a drive pipe, a chuck driven by an electric motor through a speed reducer, a water supply system including a tank, and a lubrication system including an oil tank. Drilling by this method with this equipment was done for rain reservoir construction in the Kemerovo State Regional Electric Plant, more than 45 m long underground ducts being been formed in lieu of trenches for quick laying of steel pipes 530 mm in diameter without disturbing structures above ground. If necessary, these ducts can be widened to 1060 mm and 1260 mm diameters by means of return-stroke expanders. The water flow rate is controlled by a regulating faucet, the equipment being designed for 29.4 MPa maximum water pressure and 945 kN maximum water feed thrust. Drilling by this method, with three-five times less power and with a 1.2-3.7 times higher speed than without water feed, has reduced the cost of constructing the intermediate-level rain reservoir for Power Unit No 12 by 12.5 million rubles. A simple formula has been devised for calculating the water flow rate necessary for adequately softening a bedrock. Figures 3; references 1.

UDC 697:536.24

Thermal State of Hermetic Protective Shell Around Reactor Compartment of Nuclear Power Plant Under Extreme Heat Loads

[Article by L. A. Berdichevskiy, engineer, A. A. Khalatov, doctor of technical sciences, P. K. Krukovskiy, candidate of technical sciences, and A. V. Lisovskiy, engineer]

[Abstract] The temperature fields in a double-layer protective shell around a reactor compartment in a nuclear power plant during rapid changes of the steam/air temperature inside are analyzed and calculated on the basis of a mathematical model which allows varying the temperature of the outside air and the temperature of steel sheath lining the reinforced-concrete shell structure. A shell is considered which consists of a 1200 mm thick reinforced-concrete wall (thermal conductivity 1.7 W/(m.K), specific heat 1.81 J/(cm^3.K)) and an 8 mm thick sheath of grade VSt3-5 killed steel (thermal conductivity 45 W/(m.K), specific heat also 1.81 J/(cm^3.K)) lining the wall on the inside. The coefficient of heat transfer from steam/air medium inside to the steel sheath was varied from 6.3 W/(m^2.K) corresponding to natural convection without condensation to 600 W/(m^2.K) corresponding to intense condensation, the coefficient of heat transfer from wall to ambient air was held constant at 11.6 W/(m^2.K) corresponding to free convection. Numerical analysis and calculations by the method of finite differences using an implicit scheme on a grid with 30 space nodes and 24 time nodes have yielded the steam/air temperature as a function of time and the temperature distribution across the concrete at successive instants of time during an emergency shutdown, also the dependence of the sheath temperature on the steam/air-to-sheath heat transfer coefficient at those instants of time. Figures 3; references 3.

Compact Electric-Discharge Xenon and Krypton Chloride Laser

[Article by Yu. Yu. Neymet, A. K. Shuibov, V. S. Shevera, V. N. Kuzma]

[Abstract] A compact electric-discharge xenon and krypton chloride excimer laser is developed for application to plasma physics and for analyzing molecular and atomic multiphonon processes. The laser consists of a radiator and a high-voltage power source. The output characteristics of the laser are investigated as a function of pressure and composition of the xenon and krypton chloride mixtures as well as the charge voltage. Maximum lasing energy is achieved at a wavelength of 308 nanometers in the XeCl and equals 100 millijoules in a Ne:Xe:HCl blend at a pressure ratio of 300:8:.4 kilopascals. Plots of lasing energy from these lasers as a function of discharge voltage are provided.

Black Body Model For Calibrating Filter-Type Spectrophotometers

[Article by G. I. Levashenko, N. V. Mazaev, S. L. Shuralev]

[Abstract] A black body model with a power source for use in calibrating IR filter-type spectrophotometers with an aperture diaphragm up to 25 millimeters is reported. This model consists of a radiating cavity heated by electrical current and thermocouples employing a thermovoltage meter. The radiating cavity takes the form of a cylindrical tube 180 mm in length and 40 mm in diameter along with a housing and a diaphragm system. The radiant emittance of the black body model is calculated by Quinn's formula, which accounts for single and double scattering off the inner surface, and amounts to .991. The power supply employs a phase-controlled thyristor design that makes possible economical control over the average power presented to the load. Power control is achieved by varying the phase angle. The performance specifications of the black body model are reported.

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Problems in Producing Reliable Multilevel Interconnections in VLSI Circuits

[Article by K. A. Valiyev, A. A. Orlikovskiy, A. G. Vasilyev, and V. F. Lukichev, Institute of Physics and Technology, USSR Academy of Sciences]

[Abstract] Problems in producing reliable interconnections in VLSI circuits are analyzed, aluminum being the best material for metallization because of its low electrical resistivity (2.7 µohm.cm) and low melting point (660°C) as well as strong adhesion to dielectric materials and silicon. The major problems in producing reliable aluminum interconnections generally are related to mass transfer along aluminum tracks, owing to the high solubility of silicon in aluminum but also to electromigration of aluminum tracks. Small additions of Cu and Si inhibit electromigration, but they also increase the electrical resistivity (by 0.5 µohm.cm per 1% Cu and by 0.7 µohm.cm per 1% Si). The optimum tradeoff is 0.5% Cu for formation of a "bamboo" structure. Another problem arises in heat treatment of aluminum films, namely formation of burrs and pits as a result of self-diffusion as well as of diffusion along grain boundaries. These problems escalate in multilevel VLSI circuits and solutions continue to be sought as higher degrees of integration become attainable. In bipolar structures, featuring both high speed and high current density, silicides (PtSi or Pd_2Si) being used for contact tabs and thin layers of the W+ 10% Ti alloy are used as barrier between Al and Si. On both second and third levels, moreover, aluminum may be replaced with gold but barrier interlayers still remains. The degree of integration in MOS structures is now increasing exponentially with time and scaling down, which would results in a proportionally increasing current density, requires increasing the electrical resistivity and this in turn would correspondingly lengthen the signal delay time so that interconnections in the form of metallized silicon or polysilicon regions are not acceptable here. Contact tabs are made again of silicides and interconnections are made of Al with small addition of Si, Cu, or Mg, with a barrier interlayer of Ti, TiN, W-Ti, or W. Advantages of the self-adaptive silicide ("salicide") process are a lateral buildup of $TiSi_2$ layers on SiO_2, the solid-phase reaction of Ti with Si limiting diffusion of Si into the Ti film, and degradation of shallow embedded p-n junctions. This is an inherently high-temperature process, moreover, which favors formation of the $TiSi_2$ phase while at 800°C it inhibits formation of Ti_5Si_3 and TiSi phases, whether the oxygen content in the Ti film is high (above 15-20%) or low (below 5%). Dielectric interlevel insulation is another problem arising in fabrication of VLSI circuits. Deposition of such an insulation must be done at temperatures not higher than 450°C and, therefore, preferably by a plasma-or photostimulated process. While SiO_2 layers are now deposited by condensation from the gaseous phase following conventional or plasma-stimulated oxidation of silane, also by conventional sputtering, deposition of Si_3N_4 layers from the gaseous phase is now plasma-stimulated, Al_2O_3 layers are produced by anodic oxidation, and polyimide layers are deposited by the rotation method. Current research and developments concern the use of high-T_c superconductor materials, particularly $Ba_2Cu_3O_{7-x}$ and $Bi_2Sr_2Ca_2Cu_3O_x$, for interconnections in MOS VLSI structures on Si, SiO_2, MgO, ZrO_2, AlN, sapphire, $SrTiO_3$, Si+ $BaTiO_3$ with $MgAlO_3$ interlayer, or cold quartz glass substrates. An important consideration are the high-frequency characteristics of superconductor microstrip lines and the frequency dispersion of their electrophysical properties. One of the few low-temperature processes suitable for producing superconductor films is molecular-beam epitaxy. Another one successfully tried with an excimer (KrF) laser is vaporization of a ceramic target in an oxygen atmosphere, with the substrate heated to 650°C under a 5 mtorr oxygen pressure during deposition and then annealed at 450°C for 1 h under a 1 atm oxygen pressure. Figures 6; tables 6; references 46.

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High-Purity Refractory Metals in Microelectronics

[Article by V. G. Glebovskiy, Yu. Ch. Dulinets, E. A. Markaryants, and V. Yu. Yashchak, Institute of Solid-State Physics, USSR Academy of Sciences]

[Abstract] The feasibility of producing high-purity refractory metals for microelectronic devices is examined, comprehensive experimental studies having been made concerning removal of undesirable impurities. The latter include alkali metals (Na,K), radioactive metals (U,Th), gaseous and gas forming elements (H,O,N,C). While radioactive impurities can be removed only by an intricate chemical purification process, the basic two methods of removing gaseous and gas forming impurities are high-temperature annealing or smelting under vacuum. The suitable method depends on the metal, considering that from metals of the Mo,W group oxygen is readily desorbable either intrinsically or in the form of oxides, while from metals of the Ti,V,Cr group it is not desorbable owing to its much stronger and thermochemically more stable bond to these host metals than the bond between these metals and their oxides, and in metals of the Zr,Hf, Nb,Ta group oxygen is in an intermediate situation. Carbon is not desorbable at all and can be removed only by reaction with ambient free oxygen into desorbable CO molecules. Metallurgical methods and analytical methods were used in these studies. Multiple electron-beam remelting and supplementary electric-arc smelting under vacuum were found to yield the highest purity. By this method were produced cylindrical ingots, one lot after two remelting

cycles in a furnace, one lot similarly but in vertical flat crystallizers, and one lot of rectangular as well as cylindrical ingots similarly but in horizontal flat crystallizers. Analytical methods of product inspection and examination included neutron- and deuteron-activation, spark-gap mass spectrometry, and atom absorption. Films of those metals ranging in thickness from 0.3 to 1 μm were deposited on silicon substrates, with or without 0.3 μm thick thermal SiO_2 interlayers, by magnetron sputtering of the various ingots with the silicon plates held at temperatures of 300-350°C. Subsequent structural examination and analysis revealed the specifics their formation, electrical resistance measurements yielding quantitative data on the attendant increase of electrical resistivity as indicator of the degree of purity. The next concern were the silicides of those metals, the highest temperature at which they would form and the electrical resistivity of silicide films. Silicide films for this study were produced by powder metallurgy and by sputtering plus annealing, $TiSi_2$ as well as $MoSi_2$ and $TaSi_2$ also by cosputtering. An important consideration in this study were the nature of the silicide-silicon interface and formation of silicide barrier interlayers, an important factor determining the suitability of those metals for microelectronics and particularly VLSI. Tables 5; references 18.

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Planarization of Conductor Relief in Multilevel Interconnections in VLSI Circuits

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[Article by A. S. Valeyev, V. A. Shishko, and A. D. Sulimin, Scientific Research Institute of Molecular Electronics]

[Abstract] Planarization of aluminum interconnections on insulator substrates in multilevel VLSI circuits is described, the process involving deposition of a dielectric film to cover the conductors and fill the clearances between them, subsequent formation of an organic film on top of the dielectric to smoothen the relief, and plasmochemical etching of both films. Each stage of the planarization process is examined and the effectiveness of this method is evaluated, the main factors which determine its effectiveness being ability of an organic film to smoothen the relief and transfer of the surface relief profile from organic film onto dielectric coating. An experimental study was made for which organic films were deposited by centrifugal casting of various photoresists (FP 051K, FP 051T, FP 383, FN 11, FPRN 7-2) on coated conductors with a different topology each. The smoothing effect of such films has been evaluated by analyzing the results of this experiment in terms of two planarization coefficients $K_p= 1- \Delta h_p/h_r$ (Δh_p- asperity depth in relief of organic film along a given conductor segment, h_r- asperity height in original relief of conductor) and $K_c=\Delta h_c/h_r$ (Δh_c- asperity height in original

relief of clearance between conductors). On this basis is then analyzed transformation of the original conductor relief by the smoothing process and subsequent plasmochemical etching. This analysis reveals that the planarization coefficients depend on the original conductor topology, on the nominal thicknesses of both dielectric and organic films, on the nonuniformity of their thicknesses, and on the etching rate. Ways to to minimize the residual relief asperity Δh_r- Δh_c are accordingly to maximize the precision and optimize the sequence of each operation. The final outcome of such a planarization will then depend on both shape and thickness of the edge of the photoresist mask above the conductor edge, the pattern of this dependence not yet having been established. Figures 6; tables 2; references 4.

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Superconducting Thin Films and Possibilities of Their Use in Microelectronics

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[Article by Ye. A. Antonova, Moscow Institute of Steel and Alloys]

[Abstract] The feasibility of using thin films of high-T_c superconductor materials, particularly $YBa_2Cu_3O_{7-x}$ ($T_c \approx 90$ K), $Bi_2Sr_2Ca_2Cu_3O_x$ ($T_c \approx 105$ K), and $Tl_2Ba_2Ca_2Cu_3O_x$ ($T_c \approx 115$ K) in microelectronic devices as well as for interconnections interconnections is examined from the standpoint of decreasing the heat dissipation and lowering the noise level while raising both the operating speed and the reliability. This would allow a higher packing density and thus a higher degree of miniaturization or circuit integration. Availability of such stable high-T_c superconductor materials performing well at liquid-N_2 temperatures (77 K) does not yet eliminate the need for low-T_c superconductor materials performing well at liquid-He temperatures (4.2 K) in various high-precision measuring instruments. Most suitable among them is NbN, with a critical temperature $T_c \approx 17$ K, a high residual electrical resistivity of 50-2000 μohm.cm, a critical current density of $10^3 - 10^7$ depending on the microstructure, and a high upper critical magnetic field up to 25 T. Precision measuring instruments with Josephson junctions are of particular interest, weak links being attainable by formation of planar sandwich structures (S-I-S, SuperC-SemiC-SuperC, S-N-S), of point junctions with superconductor needle and superconductor film separated by insulator, or of bridge structures. Only sandwich structures are technologically feasible for microelectronics with a high degree of circuit integration, reproducibility of point junctions and of bridges as narrow as the coherence length within necessarily narrow tolerance limits being poor. While most adaptable to various substrates are still sandwiches with Nb or NbN as base electrode and adamantine carbon film as barrier, single-layer single-crystal films of the Y-Ba-Cu-O 123-phase

have already been epitaxially grown on $SrTiO_3$, ZrO_2:Y, and MgO substrates with cubic lattices. For application in microelectronics, the critical temperature for such films on substrates such as sapphire or or silicon single crystals (with a buffer interlayer on silicon) should not be lower than 83-84 K within a 2 K wide superconducting transition range. References 10.

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Optical Interconnections in Integrated Circuits

[Article by Yu. V. Gulyayev, M. I. Yelinson, and P. I. Perov, Institute of Radio Engineering and Electronics, USSR Academy of Sciences]

[Abstract] Considering that electrical interconnections in integrated circuits become the factor which limits the operating speed of active devices as the degree of circuit integration is raised and that replacement of narrow aluminum conductors which behave like distributed RC transmission lines with high-T_c superconductors does not completely solve the problem, crosstalk and degradation not being eliminated and the current density still being limited, use of optical interconnections has been proposed as a remedy. The most practical way of using optical signals in computers, for instance, is by integration of electronic data processing components and optical data transmission components. This will combine low energy requirement with high operating speed, at the cost of added electrical-to-optical and optical-to-electrical signal conversions. Electronic data processing devices require, however, much less energy than the luminous switching energy required by bistable optical logic. Optical interconnections consist of three basic components: output stages of the integrated circuit where electrical signals are converted into optical ones, distribution network which transfers optical signals to their destinations, and input stages of the integrated circuit where optical signals are converted into electrical ones for processing by electronic devices. As output devices are now considered only semiconductor lasers, typically a GaAs single quantum well bounded by graded-index AlGaAs layers and GaAs-AlGaAs sublattices, and light modulators such as one based on the Keldysh-Franz effect. An arrays of those lasers can be used with Bragg mirrors as gratings or light modulators can be built into the integrated system and combined with external light sources, an important consideration in the latter case being compatibility of the modulator with the other components of the integrated circuit.

Transmission of optical signals can be effected over various media, the simplest being optical fibers but more effective being integrated optical waveguides and also promising being transmission over open space with use of holograms. Figures 2; references 66.

UDC 621.372.826

Fiber Optics For Visible and Near Infrared Light

[Article by Ye. M. Dianov and O. G. Okhotnikov, Institute of General Physics, USSR Academy of Sciences]

[Abstract] A survey of research and developments in the 1980's pertaining to fiber optics is presented which covers both and applications. Following a general review of the basic design and performance criteria for multimode and single-mode fibers, including the ratio of core diameter to wavelength in vacuum as well as the numerical aperture and the attenuation or loss coefficient, quartz glass is found to be most widely used for the core of fibers transmitting visible or near infrared light. Other multicomponent silicate glasses such as those containing fluorides of heavy metals or chalcogenides are becoming less adequate according to increasingly stringent requirements. Polycrystalline alkali-halide fibers have been recently developed, especially for operation with CO_2-lasers at wavelengths within the 9-11 μm band. Quartz glass still remains an important basic core material and, therefore, fabrication of such fibers is reviewed in detail from chemical deposition of tubular ingots from the gaseous phase, the MCVD method being now employed in the USSR, to subsequent extrusion of filaments. Both stages of the process require high-precision equipment and a high degree of automation. As an interesting application for single-mode fibers is described and explained their use as couplers in coherent-light optics. A very difficult problem here is facilitating entry of light from a semiconductor laser, especially from an injection semiconductor laser, into such an optical fiber. Most successful has been found to be tapering the fiber tip into an adiabatic cone and terminating it into a microlens, which ensures that up to 70% of incident light will enter without distortion of its modal content. The authors have proposed a further refinement, namely a selective conical tip terminating into a spherical microlens. Tests performed with this device indicate that, owing to suppression of undesirable spectral components, only up to 55% of incident light will enter the fiber. Figures 6; references 24.

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